Poster Session 2

P2 – 1

THERMAL EFFECT OF RADIATION ON DUST PARTICLES

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Cosmic dust grains are an important component of the interstellar medium. They play a central role in the star-formation process, the energy balance of gas clouds and so on. For the calculation of the thermal effect of various kinds of radiation on dust particles the absorption and heating of particles have to be known over a wide interval of particle composition and sizes. As dust grains may be both uniform and composite collections of particles of distinct materials, including voids agglomerated together, such particles can be simulated by homogeneous spheres and by a series of concentric spherical layers, each of which has the optical properties of one material or vacuum. The one-layer grains of amorphous silicate and carbonaceous material are considered. Then composite grains with two materials: amorphous carbon and vacuum or amorphous silicate particles coated with a carbonaceous "mantle" will be examined. Some computer codes for calculations of internal intensity distributions in multilayer particles and heating of them were developed.

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CALCULATION OF OPTICAL FIELDS INSIDE SPHEROIDAL PARTICLES OF COSMIC DUST: COMPARISON OF DIFFERENT METHODS: GMT, T - MATRIX, SVM

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The thermal effects (heating, evaporation, destruction, etc.) that occur during electromagnetic wave interaction with particles of cosmic dust play an important role in physics of the interstellar medium. Effective numerical methods for evaluation of internal electromagnetic fields are in great demand in such areas as astrophysics, laser technology and manifold industrial applications where thermo-optical and nonlinear effects in small non-spherical particles need to be investigated. We use three methods (General Multipole Technique (GMT), Separation of Variables Method (SVM), and T-matrix approach) to calculate the optical fields inside spheroidal particles. The parallel use of these significantly different approaches allows us to obtain benchmark results.

We compare the codes with respect to computer time, precision and effectiveness for internal field calculations for prolate spheroidal grains of astronomical silicates.

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P2 – 3

COSMOLOGICAL PRINCIPLE AND RELATIVITY

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Standard model for cosmology presumes the universal validity of the locally discovered physical laws and considers a space expansion to explain the differences between cosmic and local observations. Here, we consider that the locally discovered physical laws are just the local limit of general laws and we establish those general laws from both local and cosmic data, satisfying Relativity Principle (RP). This approach is not new, Galileo and Newton being the first to explain both local and cosmic phenomena by the same laws. We called Local Relativity (LR) to our framework.

In LR, whatever the position in time and space, local laws are always the current laws, RP has universal validity, and it applies to any scale. Relativity Principle has the role of the law of laws and embodies Cosmological Principle. LR verifies solar system measures and classic cosmic tests, the results being compared with Friedmann models. New results are obtained, as an accelerating component in earth rotation (dLOD = -0.4 ms cy^{-1}), compatible with VLBI and GPS measures. The work is organized in two parts; part I is at xxx.lanl.gov/abs/physics/0205033 and part II is available from July.

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EFFECT OF THE POTENTIAL TOPOLOGY ON PREDISSOCIATION DYNAMICS OF VAN DER WAALS CLUSTERS

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The potential Energy Surfaces of the ground electronic state of rare gas halogens van der Waals (vdW) molecules are calculated at CCSD(T) (coupled cluster usind single and double excitations with a noniterative perturbation treatment of triple excitations) level of theory. Calculations are performed with specific augmented correlation consistent basis sets for rare gas atom, supplemented with a set of mid-bond functions. For halogen atoms a correlation consistent triple zeta valence basis set in conjunction with large-core Stuttgart-Dresden-Bonn (SDB) relativistic pseudopotentials are employed.

The CCSD(T) results predict minima in linear and T-shape configurations on the potential energy surfaces of the vdW complexes. Energy Positions, lifetimes and final rotational state distributions are determined for vibrational predissociation from these two minima. Comparison with experimental data provides information on the structure of the ground potential energy surfaces of the vdW clusters.

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MOLECULAR ELECTRON EXPERIENCING A DIFFRACTION GRATING INDUCED BYULTRAFAST MULTIPHOTON EXCITATION

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We intend to insight the rich information which is involved in the interaction of an individual molecule possessing an axis of symmetry and an ultrashort polarized optical pulse. In so doing, we give first evidence for the critical dependence of the induced electric dipole on the initial conditions of a rotationally frozen molecule; orientation of the molecular frame during the short excitation time interval, symmetry of the resonant electronic states, number of absorbed photons and number of coherently excited rotational states. The characteristics of the short optical pulse in conjuction with the rotational constants and the initial molecular conditions will constitute for the quantum system a quantum information stored in the time evolution of the molecular excited electron. This information being carried at least in a nanosecond time-scale it can be regarded as a *"long time-scale property"* given that it is compared to an excitation time interval short compared to a simple molecular rotation. The time evolution of the rotational wavepacket carried by the molecular electron and the subsequent rotation of the excited molecule must be functions of β and β', the molecular orientation for the ground and excited state. For the ultrafast excitation these two orientations are in a coherent superposition and the physical quantities to be considered are rather the mean orientation $\beta^*(t)=1/2(\beta'+\beta)$ and the angular spread $\beta^{\sim}(t)=1/2(\beta'-\beta)$, since β and β' cannot be defined separately. Furthermore, in the above circumstances the spectral profile of the short pulse must be taken explicitly into account.

We have derived an analytical expression for the excitation process in terms of physical parameters related to experimental data such as the rotational constants of the molecule and the intrinsic uncertainty in the frequency of the optical pulse. The time behaviour of a molecular excited electron experiencing both the quantum superposition of the ground and excited state orientation and the subsequent rotation of the nuclear frame, gives evidence for a *"diffracted-electric-dipole"*. The theoretical description of this *"average-free orientational polarizability"* is presented for a short optical Fourier-Limited Pulse (FLIP) whose large spectral bandwidth overlaps *N* rotational states in the excited electronic-vibrational state. For the excited electron *the FLIP induces within the rotational structure a diffraction grating* and this environment provides to the molecular electron wavefunction a characteristic interference pattern.

[1] Orientational Polarizability and diffracted-molecular-electron induced dipole, C. Mainos, J. Baudon and J. Robert, J. Phys. B: At. Mol. Opt. Phys. 35 (2002) 1679.
[2] Laser-induced coherence in ultrafast multiphoton excitation of individual molecules, C. Mainos, Phys. Rev. A, 61, 063410 (2000); 58, 3080 (1998).

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P2 – 6

6s IONIZATION ENERGIES OF LANTHANIDES

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Modern methods of contemporary theoretical atomic spectroscopy must allow to study the most complex many-electron atoms of periodical table as well as their ions of various ionization degrees. Such a universal approach, based on tensorial algebra, irreducable tensorial sets, second quantization in coupled tensorial form combined with the intense use of quasispin space [1], is described in [2,3,4]. The relevant computer codes allow to study the configurations with open f-shells without any restrictions. This paper may serve as one of the illustrations of such a statement.

The multiconfigurational Hartree-Fock method is used for the investigation of ionization potentials of a number of lanthanides. The ground ([Xe] $6s^2$ $4f^N$ LS) and excited ([Xe] 6s $4f^N$) states of Pr, Nd, Pm, Sm, Eu, Tb, Dy, Ho, Er, Tm and Yb are considered . The calculations were carried out for various sets of restricted active space accounting for relativistic effects as corrections in Hartree-Fock-Pauli approximation. The results obtained are in fairly good agreement with the relevant experimental data.

For example, the ionization energy of Sm is obtained equal to 5.485 eV (column IE in Table presented below) when accounting for the relativistic shift corrections. Sekiay et all [5] ab initio result obtained in the non-relativistic CI approximation equals 4.932 eV whereas CI with Davidson Q correction leads to 5.089 eV and with estimated relativistic corrections the value is 5.33 eV (column CI). Thus our result is closer to experimental value 5.644 eV [6,7]. Similar accuracy may be achieved for the other lanthanides too.

Atom, CI, IE, Exp[6,7], Atom, CI, IE, Exp[6,7]
Sm, 5.33, 5.485, 5.644, Dy, 5.47, 5.557, 5.939
Tb, 5.45, 5.530, 5.864, Er, 5.58, 5.878, 6.108

Therefore, the method [1,2,3] may be efficiently used for studies of ionization energies of lanthanides.

[1] Z. Rudzikas Theoretical atomic spectroscopy (Cambridge University Press, Cambridge 1997)
[2] G. Gaigalas, Z. Rudzikas and Ch. Froese Fischer, J. Phys. B: Atomic, Molecular and Optical Physics 30, 3747 (1997).
[3] G. Gaigalas, Lithuanian Journal of Physics, 41, 39 (2001)
[4] Ch. Froese Fischer, Comput. Phys. Commun. 64, 369 (1991)
[5] M. Sekiay, F. Sasaki and H. Tatewaki, Phys. Rev. A56, 2731 (1997)
[6] W. C. Martin, R. Zalubas and L. Hagan, Natl. Bur. Stand. Circ. No. 60 (U.S. GPO, Washington D.C., 1978)
[7] W. C. Martin, L. Hagan, J. Reader and J. Sugar, J. Phys. Chem. Ref. Data 3, 771 (1974); L. Brewer, J. Opt. Soc. Am. 61, 1101 (1971)

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P2 – 7

ON THE INTEGRAL OF THE FORM - int[F(ox+l)exp[(i*pi/2)squared(ax-b)]dx – IN DIFFRACTION THEORY

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Representation of the integral of this form is not well-known in literature and its appearance in the treatment of diffraction theory of the geometry of inclined apertures is an obstacle for many problems that need to be solved. Kirchhoff's integral, in the analysis of the diffraction phenomena with conventional light sources or of the laser beam in holography, can be utilized successfully only for certain shapes of the apertures. According to this fact, it is quite clear why such problems remain unsolved. It was an attempt in this work, to present another way for solving the problems of this kind, and it seems that this is the only direction in which the solution has to be searched. This integral can be integrated in the open form, but such solutions are not practical.

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COMPUTER INVESTIGATION OF PERCOLATION PROCESSES IN TWO- AND TREE- DIMENSIONAL SYSTEMS WITH HETEROGENEOUS INTERNAL STRUCTURE

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As known, the percolation model has been found useful to characterize many disordered systems, such as porous media, fragmentation and fractures, gelation, random-resister insulator systems, dispersed ionic conductors, forest fires and epidemics. Hoshen and Kopelman developed the cluster formalism for description energy transport in disordered media [1]. But experimental results of the energy transport research differed from the theoretical ones were found when the porous glass was used as the matrix. This effect was connected [2] with the heterogeneous properties of porous glasses.

We have developed the computational technique in order to investigate the influence of the internal structure on energy transport in the heterogeneous systems. Under our consideration was square lattice with randomly arranged square obstacles. Were calculated such important percolation characteristics of the system as critical concentration, percolation probability, average finite cluster size, the values of critical exponents, the fractal and spectral dimensions of percolation cluster in critical point. The strong influence of linear size & concentration of the obstacles on them was shown in our resent work [3].

In our investigation theory of system A^1 [4] for mathematical definition of the physical model and percolation theory [5] for interpretation of obtained data were applied. And in this paper the results of the heterogeneous condition preparation, the percolation cluster growth and the mentioned above features calculation are discussed.

[1] Hoshen J., Kopelman R. J., Chem. Phys., 65, 2817 (1976)
[2] Bagnich S.A., Phys. Solid State, 42, 1775 (2000)
[3] Bagnich S.A. Konash A.V., J. Phys. A (submitted)
[4] Novikova S. at el., proceedings of IFAC/IFORS/IMACS symposium on large scale systems, LSS'98, Patras, Greece (1998) p.1024
[5] Broadbent S.R., Hammersly J.M., Proc. Camb. Phil. Soc., 53, 626 (1957)

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P2 – 9

CONNECTION OF THE PARTICLES CHARGES WITH THEIR SIZE DISTRIBUTION IN DUSTY PLASMA SYSTEMS

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In statistic equilibrium the Coulomb microinhomogeneities in heterogeneous plasma system (HPS) must correspond to the minimum of the Coulomb contribution to the Helmholtz free energy functional. In the present work with the help of ideas of the statistical model of quasineutral cells of HPS we proposed the way to take into account the dispersion of CDPh which is based on the minimization of the HPS free energy functional. The sequence of realization of numeric calculation in the method proposed is the following:1.For some volume of an electroneutral cell in a given region of changing of ksi on the formula we calculate the Coulomb contribution to the HPS free energy. 2.The minimization of this contribution on the parameter gives the possibility to determine the size of the electroneutrality cell in polydispersed HPS.3.Starting from the obtain size of the electroneutrality domain of HPS we calculate electrophysical parameters of the system: charges of dispersed particles, the distribution of self-consistent electric field in the vicinity of individual macroparticles, and the free electron concentration in gas phase.

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CREEP RUPTURE OF FIBER BUNDLES

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Under high steady stresses fiber composites may undergo time dependent deformation resulting in failure called creep rupture which limits their lifetime, and hence, has a high impact on the applicability of these materials in construction elements. Both natural fiber composites like wood and various types of fiber reinforced composites show creep rupture phenomena, which have attracted continuous theoretical and experimental interest over the past years. Besides its obvious practical importance, creep rupture, similarly to other rupture phenomena, presents a very interesting problem for statistical physics, it is still an open problem to embed creep rupture into the general framework of statistical physics to understand the analogy between rupture phenomena and phase transitions.

We study the creep rupture of fiber composites in the framework of fiber bundle models. We introduced two novel fiber bundle models based on different microscopic mechanisms responsible for the macroscopic creep behaviour. In the first approach the fibers themselves are viscoelastic and they break when their deformation exceeds a stochastically distributed threshold value. They are modelled by a spring and a dashpot in parallel. Broken fibers hold no load. In the second model the fibers are linearly elastic until they break stochastically, they are modelled by springs. However, when a fiber breaks its load does not drop to zero intanteneously, it undergoes a slow relaxation process, which introduces a time scale into the system. This can be caused by the sliding of the broken fiber with respect to the matrix material or the yielding of the matrix. The matrix do not explicitly appear in a fiber bundle model, so the above behaviour is modelled by taking the broken fiber as a serial coupling of a spring and a dashpot.

For both models we considered global load sharing for the redistribution of load following fiber failure: the extra load a fiber gets does not depend on its distance from the failed fiber. With this simplification we could derive analytical formulae for the behaviour of the model systems, and also develop efficient simulation techniques.

Both analytical and numerical calculations show that above a critical load the deformation of the creeping system monotonically increases in time resulting in global failure with all fibers broken at a finite time, while below the critical load the deformation tends to a constant value giving rise to an infinite lifetime. However, the characteristic time of the system relaxing towards the equilibrium deformation diverges according to a power law with a universal exponent as the critical load is approached. Furthermore, above the critical point the lifetime of the system shows the same universal power law divergence with the same exponent.

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We also investigated the dependence of the lifetime of the composit above the critical load on the number of fibers in the bundle. We have derived analytical formula valid for a range of conceivable fibre bundle models of creep rupture including our two models with a general distribution of the failing thresholds. It shows that the lifetime of the composite above the critical point has a universal dependence on the system size.

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TRAIL FORMATION IN A DIRECT WALKER MODEL WITH FEEDBACK

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Various species use an external memory for navigation, e.g. by setting chemical or visual signposts. Such an external storage of information plays an important role in establishing impressive trail systems. We apply the concept of a random walker with self induced feedback on directed walks. The directed motion of the walk reflects the tendency of animals to go forward and following a global direction, instead of frequently changing their main direction like a simple random walker. Additionally, the self induced feedback realizes the local rules of navigation. This model allows the study of the indirect collective phenomenon of trail formation, which is widely spread in the world of animals and humans. In particular, the walkers do not interact directly with each other, but each walker is able to follow the traces formed by previous walkers. Our model allows us to derive universal laws of trail formation and to study what kind of indirect interaction may lead to special trail structures.

The model is studied by numerical simulations and statistical approaches. The structure of the trail systems depends strongly on the microscopic realization of the feedback mechanism and on the general repulsive or attractive intercation between different pathes. A repulsive feedback generates ergodic states, i.e. small initial structural differences of the trail system disappear in the long time limit. A nontrivial situation occurs for an attractive feedback. During the evolution of the trail system we can distinguish between an initial regime and a long time regime. The first one is a rather random movement and no pronounced trail exists. But during the second regime a distinct network of major trails (or only one dominant trail) appears, which is amplified by all subsequent walkers moving on the trail. Typically, the trail systems are nonergodic. A surprising result is that a site feedback leads to trail systems with one straight dominant path up to microscopic scales whereas a bond feedback generates main trails similar to free directed walks.

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REFORM OF PHYSICS EDUCATION IN USA AND ITS CONSEQUENCES FOR POLISH EDUCATION SYSTEM

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Since few years Community of American physicists has provided activities in order a realisation of the reform physics education. These activities created important trends of reform of education system in USA and led to full success. This success is connected with realisation of election promise by the president George Bush who has decided that education is the first case for new administration. Different activities of physicists' community were supported by American Physical Society and American Association of Physics Teachers. Also editors of scientific journals agreed to publish articles relating to reform of education system. These were not only journals for teachers like The Physics Teacher but also well-known scientific journals like American Journal of Physics. Editor of American Journal of Physics destined special supplement for discussion on education reform. Authors of this paper as a group of educational experts indicated roads and forms leading to success of carry out the reform of education system.

Present situation of physics education in Poland is connected with an introducing modern education reform. This reform belongs to a series of reforms to process of political and economic system transformations since 1989. In the instance of education reform, the government activities to realise the changes in education structures, teaching, examination system as well as rules of teachers' employment and estimation are joined in integration process preparing an accession to the European Union.

The intention of authors of this paper is to show how polish physicists can improve the reform of education system. There are some groups of active physics teachers who could lead these activities. The initiative of polish teachers' environment is a organisation the National Seminar on Physics Teaching Methods preparing active physics teachers for teachers' leaders and mentors. This Seminar is under the auspieces of the Polish Physical Society and it is independent of the Education Ministry and local authorities.

The general topics of these propositions were presented and discussed during the 36th Meeting of Polish Physicists in Torun, September 2001.

E. Pietras, E. Rydygier: Reform of physics education in USA, *Physics in School* (journal for teachers), March 2002 (extended version the paper presented at the 36th Meeting of Polish Physicists, Torun, Poland, September 2001).
E. Pietras, E. Rydygier, K. Turzyniecki: Physics education and training physics teachers in Poland in the face of an European integration, *Proc. 11th General Conference of the European Physical Society on Trends in Physics*, London, September 1999, pp. 66-67.

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P2 – 13

SIMULATION OF AXIAL CHANNELING. QUANTUM-MECHANICAL APPROACH

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Interest in the passage of charged particles through crystals first appeared at the beginning of the century following experiments on *x*-ray diffraction in crystal lattices. Stark put forward the hypothesis that certain directions in a crystal should be relatively transparent for charged particles. This first idea on the channeling of charged particles in crystals had been forgotten and became topical again in the early sixties when the channeling effect was rediscovered by computer simulations and experiments which revealed anomalously ion penetration in crystals.

When particles energy is less then a few MeV, some quantum effects, like particle diffraction, may be important even in heavy particle channeling. In these cases a quantum-mechanical treatment of channeling is necessary.

Lervig et al. use the fact that for well channeled particles the energy in the beam direction is nearly constant, thus the motion in the transverse plane can be describe by time-dependent Schrödinger equation.

Scattering like a time-dependent phenomenon for the first time was treated by Goldberg, Schey and Schwarz. With help of computer-generated motion picture, which are obtained by numerical integration of time-dependent Schrödinger equation, they described scattering of a particle by potential barrier.

In this paper we consider the axial channeling effect like a time-dependent phenomenon. The system under consideration is an ion "moving" along axial channels of straight Si crystal. We assume that the ion-atom interaction potential, in transverse plane, is given by combination of four cylindrical barriers and one cylindrical well. The initial (normalized) wave packet is chosen to be a Gaussian and the basic parameters of the wave packet and potential are chosen to hold the main conditions of the channeling effect. It is well known that when the impact parameter is small, the transversal motion of channeled ions can be considered as oscillatory one around the center of the channel. In that case, the number of the oscillations of the ion in the crystal depends on its energy.

As a result of our numerical calculations, which are restricted to channeling of the one ion per channel, "sequences" of the time evolution of the initial wave packet are obtained. On these "moving pictires" can be seen the oscillatory behavior of the wave packet around the center of the channel which corresponds of the motion of "well" channeled ion in <100> axial channel of Si.

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CUTTING KNIVES DEFECTS REVEALING USING MAGNETIC FLUIDS

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Detachable rotative cutting knives are used for making holes in coal, low and medium durity rocks or materials. These tools are made from a steel core and two cutting plates of hard alloys – metallic wolfram carbures and cobalt.

The adding of the cutting plates on the knife core is obtained by brassing, using 0.2 mm thick brass plate and an electric induction method. The brass heating and melting, depend on alternative current frequency and initial processing of the brassed surfaces. Defects as nonuniformities of the brass layer or small cavities can appear during this process. Small internal fissures can also appear during the knife use in the cutting process.

Some theoretical and experimentalstudies have shown that the nondestructive testing of ferro- and ferrimagnetic pieces using magnetic fluids is a simple and precise method to put into evidence any nonuniformity in the pieces determining the apparition of a magnetic field gradient. The paper presents a theoretical and experimental investigation of the possibility to use this method in the case of rock cutting knives.

Figure 1

Figure 2

Experimental results were obtained for several cutting knives magnetized using a usual permanent magnet applied on the opposite side of the knife core with respect to the analyzed cutting plate. Pictures of the magnetic fluid layer after two minutes were obtained using a photo camera and were processed on a PC.

Almost cutting knives did not have defects on both cutting plates. Figure 1 present an example. No significant variations of the magnetic fluid layer thickness (related to the gray tone of pixels in the cutting plates area), except the plate boundaries, can be observed.

Figure 2 shows the image of a cutting knife with defect. Two large zones with higher contrast can be seen here. One indicates a fissure or linear zone of discontinuity. This fissure, of about 0.2 mm thickness, were also directly (optically) observed by us at the plate left boundary, but its length could not be determined in this way. The image also shows a large defect, in the left-upper part of the plate, having a non-uniform brass layer put into evidence by the strong variation of the gray tone.

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HYPERFINE MAGNETIC FIELDS AT NUCLEI IN DISORDERED AND PARTLY DISORDERED METAL - METALLOID ALLOYS

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Binary and ternary alloys on the basis of Fe, Cr, Si and Sn are considered in the paper. Numerous experimental data available in the literature are interpreted with the help of the "first-principles" calculations made by the LAPW method. The investigation revealed the following features of the hyperfine magnetic field (HFF) formation. To describe the HFF in the alloys three main contributions should be taken into account: the polarizations of the core and valence electrons (the Fermi-contact contribution) and the orbital contribution. Particular attention is given in this paper to the polarization of the valence electrons. The polarization dependence on the kind of metalloid atom and the local lattice distortion is studied. For example, it is shown that the lattice relaxation can be neglected for the valence electron polarization at Fe, Cr nuclei, whereas at Sn the local distortions result in the significant change in HFF.

An analysis of phenomenological models that are every so often used for the HFF description in disordered metal - metalloid alloys is conducted. In particular, it showed inadequacy of the additivity used in description of the alterations of the valence electron polarization at Fe, Cr caused by the metalloid atoms of the nearest spheres. At the same time the polarization change caused by the atoms of the third or more distant spheres may be considered as additive contributions and constant in the concentration range 5-8 at.%.

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EXCITON - DONOR COMPLEXES IN A SEMICONDUCTOR QUANTUM DOT

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Optical properties of three dimensionally confined electrons and holes in semiconductor quantum dots (QD) have been extensively studied in recent years. In QD due to strong overlapping between the wave functions of the electrons and the holes the complexes of the quasiparticles such as biexcitons, trions or impurity bound excitons become stabile as compared to bulk semiconductor, where their existence depends on specific stability conditions.

In this paper we have investigated the energy of the ground state of a charged and neutral complexes which consist of exciton bound to a positive singly charged or neutral donor in a semiconductor QD, using the models both an infinite and a finite potential barrier. The theoretical analysis is carried out using a variational approach for a semiconductor with parabolic energy bands. For the simplicity the impurity is taken to be fixed in the center of the spherical QD with the radius d. In the adiabatic approximation $\sigma = m_e / m_h << 1$ (m_e and m_h are the effective masses of electron and hole) the trial wave function of the system is a product of electron and hole wave functions $\Psi = g(r_a, r_b, R) f(R)$ [1], where r_a and r_b are the distances of electron from the impurity center and the hole correspondingly, R is the distance between the impurity center and the hole. We have chosen the electronic wave function of the charged complex in the form $g = C \exp(-\delta(r_a + r_b)/R) J_0(kr_a)$, where δ is the variational parameter, k_1 is the first root of the spherical Bessel function $J_0(k_1 r_a)$. The wave function of the hole $f(R)$ is the solution of the hypergeometrical equation with the boundary condition $f(d) = 0$. The variation of the energy of the ground state with respect to δ (at the fixed value of σ) was performed for different values of d and σ. On the base of these dates have been obtained the curves for the dependence of the binding energy of the charged complex from the radius of QD. It has been obtained strong increase of the binding energy of the complex with the decrease of the radius of QD. When d becomes very large our approximation leads to the corresponding "exact" 3D value of the binding energy [2]. The analogical calculations were performed for the neutral exciton donor complex.

1. A.P.Dzhotyan,E.M.Kazarian, R.L.Enfiadjian. Thin Solid Films, 60, 279-287, 1979.
2. M.A.Lampert, Phys.Rev.Lett. 1,450, 1958.

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STRAIN OF π-ZONE IN ULTRATHIN CARBON NANOTUBE

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The calculations of Slonchevski, Vaden and McClare have shown, that graphite is half-metal with the linear law of dispersion π-electrons near the boundary of Brillouin zone. However, curvatures and the strains of sheets complicate the structure of π-band [1]. The twisting a graphene sheet in nanotube additionally influences it: reduces in subdivision of π-band [2]. At rather large diameters of nanotubes these effects are not so appreciable [3]. However, in case of ultrathin carbon nanotubes they should be taken into account.

The calculations of bands and DOS zigzag (4,4) nanotube are carried out on a model including 16 atoms in an unit cell. The z-axis is directed along the axis of the nanotube. DOS is defined by the linear tetrahedron method. The energy step was 0.027 eV in the calculation of DOS. More in detail method of calculation is described in [4].

The DOS in energy range ±2 eV near the Fermi level in a case (4,4) nanotube and monolayer of graphite was compared. Monolayer of graphite was the testing object. In a case nanotube the characteristic features of DOS is the presence of local maximas of a denseness of states which stipulated by resonance scattering p_x- and p_y-electrons on the boundaries of minibands.

The linearity in a power assotiation of the DOS in nanotube is breaked, that under our judgement, is connected to a curvature of a layer and mutual mixing p_x- and p_y-wave functions. The DOS at the Fermi level is rather great, that is the reason more increased conductivity of nanotubes [5].

E.M.Baitinger et al. Information of high schools (physics). 1986, 6, 81.
M.F.Lin, W.-K.Shung. Phys.Rev.B. 1995, 51, 12, 7592.
A.S.Kotosonov, V.V.Atragev. JETP Lett. 2000, 72, 2, 76.
M.M.Brjezinskaya, E.M.Baitinger, V.I.Kormilets. JETP. 2000, 91, 2, 393.
P.G.Collins, A.Zettl. Phys.Rev.B. 1997, 55, 15, 9391.

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P2 – 18

HIGH SENSITIVITY ION BEAM ANALYTICAL METHOD FOR STUDYING ION IMPLANTED SIC

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Silicon carbide is a wide bandgap semiconductor material with many advantages for high temperature, high power and high frequency applications. Its local doping can only be performed by ion implantation, due to the very low diffusivity of the dopants in SiC, even at high temperatures. However an equivalent ion beam irradiation creates more damage in the crystal lattice of SiC than it would be in Si. The damage process and the structural recovery after a further high temperature annealing are not yet fully understood.

Ion beam analytical methods are suitable for observing ion implantation damage. Widely used Rutherford Backscattering method combined with channeling provides information on the damage only in the silicon sublattice since the small signals from carbon are situated on a high background. In our present work the 4.26 MeV $^{12}C(\alpha,\alpha)^{12}C$ nuclear resonance was applied in channeling geometry for investigating Al implanted SiC. The sensitivity of the method on carbon is enhanced by a factor of hundred due to the presence of the resonance in the cross section of carbon. This method allows us to study separately the ion irradiation damage in the silicon and the carbon sublattice. We also followed the recovery of the crystal structure after high temperature annealing. Excitation curves are presented to show the profile of the displaced carbon atoms in the <0001> channel.

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P2 – 19

PHASE TRANSITION AND THERMAL BEHAVIOUR IN NANOSTRUCTURED ZrO_2 AFTER HEAVY ION IRRADIATION

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As was shown in the past by XRD, TEM and RBS measurements, heavy ion irradiation of nanocrystalline ZrO_2 samples using 4 MeV Kr^+ ions causes the formation of a tetragonal zirconia phase that is stable at room temperature [1]. This phase is employed in solid oxide fuel cells and oxygen sensors, but usually has to be stabilized by addition of a second phase, e.g. Y_2O_3, which is not necessary when using the process mentioned above. To investigate the thermal stability of tetragonal zirconia, a new series of zirconia samples has been prepared by means of the inert gas condensation technique (IGC) and sintered afterwards at temperatures of 900 °C or 1000 °C using forces of 12 up to 40 kN. This procedure resulted in a density higher than 5 g/cm^2 corresponding to about 90% of the theoretical value.

The samples were then irradiated by 4 MeV Kr^+ ions with fluences from 2×10^{15}/cm^2 to 2×10^{16}/cm^2 and investigated by means of x-ray diffraction (XRD). The formation of the tetragonal ZrO_2 phase, which was observed as well as the (common) monoclinic phase could be reproduced. The samples were heated at temperature steps of 100°C or 200°C up to 1300°C and studied by means of XRD after each step.

Apart from the thermal stability of the tetragonal phase we were also interested in the development of the grain sizes of both phases depending on the ionic fluence [2]. Samples that had been irradiated with a fluence of 1×10^{16}/cm^2 or above showed a thermal stability of the tetragonal phase up to the sintering temperature (see Fig. 1), whereas samples irradiated with lower fluences showed only a residual amount of this phase of about 5 vol.% at temperatures of 400-500°C. The same holds for samples irradiated with higher fluences above the sintering temperature.

No significant change in the grain size of both phases could be observed. The grain size of the monoclinic ZrO_2 phase was approximately 60 nm, and that of the tetragonal phase about 20 nm (see Fig. 2). The value of the sintering temperature and the compaction forces during the sintering process did not influence the thermal behaviour of both zirconia phases significantly. Apart from the fact that depending on the ionic fluence of the samples a thermal stability of the tetragonal phase could be achieved, an ageing stability of the tetragonal ZrO_2 phase was also observed within a time period of several years.

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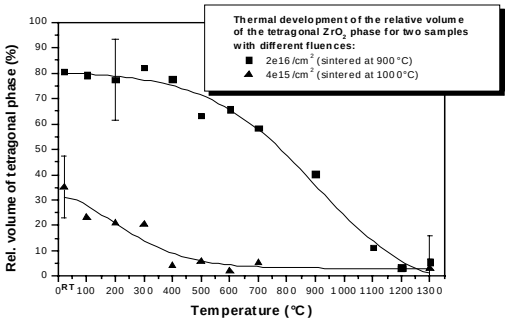

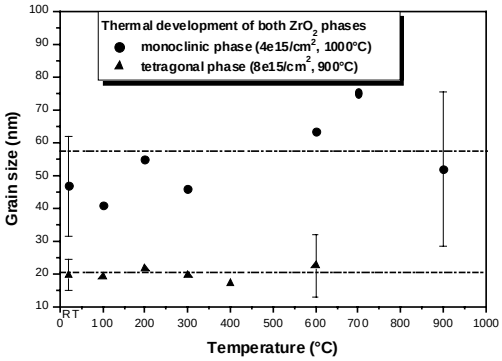

Figure 1: Thermal development of the tetragonal phase for two different samples *Figure 2:* Thermal development of the grain size of both ZrO_2 phase

[1] M. Rose, G. Gorzowski, G. Miehe, A.G. Balogh, H. Hahn: *Phase stability of nanostructured materials under heavy ion irradiation,* Nanostructured Materials 6 (1995) 731-734.
[2] W. Berky, G. Bejarano, A.G. Balogh, *Thermal behaviour of nanostructured ZrO_2 after heavy ion irradiation*, Nucl. Instr. and Meth. B, submitted for publication.

P2 – 20

UNUSUAL PROPERTIES OF HARD FULLERENE-BASED CARBONS

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We report on detailed investigations of the thermal and acoustical properties on hard fullerene-based carbons. The novel materials were obtained from pressure-temperature treatment of C_{60} and C_{70} and are known for a unique combination of their diamond-like hardness and amorphous carbon-like electrical conductivity. X-ray diffraction and high-resolution transmission electron microscopy investigations have revealed that nanocrystalline and amorphous phases co-exist in samples of both kind of hard fullerene-based carbons, i.e. C_{60} and C_{70}. The materials possess an unusual, linear or close-to-linear temperature dependence of the thermal conductivity above 20 K. Between 0.1 K and 10 K the thermal conductivity of C_{60} is characterized by a monotonous increase versus temperature (power law $T^{1.4}$, without a well defined plateau around 5-10 K. Sound velocity decreases linearly from 4 K up to 100 K. Both linear regimes are characteristic of disordered structures, and can be analysed by the phonon-fracton hopping model developed for fractal and amorphous structures. The obtained data are compared with thermal conductivity in diamond, graphite and glassy carbon and are consistent with the structure of a disordered or amorphous-like solid formed by polymerisation and partially transformed fullerene clusters.

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FROM STRAIGHT CARBON NANOTUBES TO TOROIDAL AND HELICALLY COILED TUBES

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The curved form of carbon nanotubes - torus and helical coil - were predicted on the basis of theoretical calculations [1] shortly after the discovery of carbon nanotubes. Soon, the first multiwall coiled carbon nanotubes were observed experimentally [2]. The structural models proposed for these structures are based on the very regular insertion of pentagon-heptagon pairs in a perfect hexagonal network. Although several mechanisms have been proposed to explain this very regular occurrence of non-hexagonal rings in a perfect hexagonal network, in a fraction close to 1%, the understanding of the way in which these structures are formed and arranged in an extremely regular way, is still unclear.

In the present work the earlier models are reviewed and a new model is proposed in which the ratio of non-hexagonal rings to hexagonal ones is higher than unity. In this structure, replacing a hexagon by a non-hexagonal ring, has little effect. The model is compared to STM measurements [3].

1. D. I. Dunlap, Phys. Rev. B 46 (1933) 1992, S. Ihara et al., Phys. Rev. B 47 (1993) 1703
2. S. Amelinckx et al., Science 265 (1994) 635
3. L. P. Biró et al., Europhys. Lett. 50 (2000) 494

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P2 – 22

H-BOND DYNAMICS, SLATER ICE RULES AND TAKAGI GROUP MOTION IN A KDP-TYPE DEUTERON GLASS

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We have observed the dynamics of correlated hydrogen switching among the six Slater D_2PO_4 configurations induced by unpaired D_3PO_4 and DPO_4 Takagi group diffusion in a deuteron glass $Rb_{0.5}(ND_4)_{0.5}D_2PO_4$. The results obtained by two-dimensional (2D) 31P exchange NMR prove the validity of the Slater-Takagi ice rules and allow for the direct determination of the correlation time for the unpaired Takagi group visits to a given D_2PO_4 group. They also explain the symmetry properties of these systems which are in apparent contradiction with the Slater rules.

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PECULIARITIES OF INTERATOMIC CORRELATION'S IN NI-MO ALLOYS

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It is well known fact, that existence of interatomic correlation's in alloys, which cause the short-range ordering of unlike atomic species, significantly affects various physical properties [1]. However, there exist different concepts of short-range order in alloys, based on the models of uniform and non-uniform order. Particular difficulties arise for alloys such as Ni-Mo, Au-Mn, Au-Cr, and some others, in which the formation of short-range and long-range order in stoichiometric compositions yields diffraction effects that appear at different points of reciprocal spase [2-5].

For this work, chose the Ni-11.8 at.% Mo alloy because its chemical composition is near the solubility limit of the α sold solution, which excludes thermodynamical transformations inherent in the stoichiometric Ni_4Mo alloys.

By a method of measurement of isothermal relation of a residual specific resistance for hardened samples (in temperature range 300-700 ^{0}C) at temperatures of an annealing 50 and 100 ^{0}C the transition from homogeneous up to the heterogeneous local order is shown. Such transition is explained by development of concentration waves {1½0} and their interplay at different temperatures, that is formation of clusters structures different types.

In present work, the features of relaxation times of those clusters structures and temperature areas of their existence are studied.

1. Iveronova V.I. A.A. Katznelson. The short-range order in solid solutions. M.: Science, 1977. 255 P. (published by Russia).
2. Kulkarni U.D., Banerjee S. Phase separation during the early stage of ordering in Ni_3Mo // Acta Met. 1988. V.36. №2. P.413-424.
3. Banerjee S., Kulkarni U.D., Urban K. Initial stages of ordering in Ni_3Mo.-Thermal and irradiation ordering experiments // Acta Met. 1989. V.37. №1. P.35-48.
4. Stobbs W.M., Stobbs S.H. Short-range order in <1½0> special point alloys // Phil. Mag. 1986. V.B53. №6. P.537-544.
4. V.G. Poroshin, N.P. Kulish, P.V. Petrenko, N.A. Melnikova. Interatomic correlations in alloy Ni-11.8 at. % Mo // FSS, 1999, V. 41, Issue 12, P. 2121-2126 (published by Russia).

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P2 – 24

THE STUDY OF THE INTERFACE LAYER BY HETEROJUNCTIONS OF ITO-CDS-CDTE-ME TYPE

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CdS-CdTe heterojunctions are used in solar cells technology, own to their spectral range of photosensitivity, which overlaps to the solar emission spectrum.
Thin films of CdS and CdTe have been prepared by thermal evaporation under vacuum by quasi-closed technique. CdS and CdTe crystals obtained from Cd(1000), Te and S chemically pure were used as vaporization sources. An ITO film prepared by pyrolize was used as transparent electrode for solar cell.
The investigated structures become highly photosensitive after heat treatment performed in a $CdCl_2$ solution, at ~400 ^oC.
In the present work photoluminescence (PL) spectra from CdS film surface, excited by a N_2 laser radiation (λ=334.0 nm), CdTe film surface, as well from layer by junction interface, excited with a He-Ne laser (λ=632.8 nm) are analysed.
The presence of excitonic lines of bond excitons by ionised centres in CdS and CdTe attests on the quality of as prepared junctions.
The heat treatment in a $CdCl_2$ solution results in the removal of defects-PL spectrum of layer from junction interface contains only the free exciton line in CdTe, localised at 1.580 eV (at T=78 K), as well an impurity band, conditioned by the level at ~0.14 eV above the top of valence band.
I-V characteristics, as well the structure of radiative spectra in dependence of temperature of heat treatment (in $CdCl_2$ solution) are also analysed.

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P2 – 25

GENERALIZED TWO-LEVEL RELAXATION MODEL FOR MÖSSBAUER SPECTRA OF NANOSTRUCTURED FERROMAGNETIC ALLOYS

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The recently-developed generalized two-level relaxation model [A. M. Afanas‘ev and M. A. Chuev, JETP Lett. 74, 107 (2001)] has been successfully performedfor the simplest treatment of the complex ^{57}Fe Mössbauer absorption spectra of nanostructured Fe-Cu-Nb-B alloys. This model applied for a system of superparamagnetic particles allows one to take into account the interparticle interaction in a simpler form and to describe qualitatively a specifically asymmetric shape of Mössbauer lines with sharp outer and smeared inward sides when the conventional two-level relaxation model fails. The generalized two-level relaxation model proved to be rather efficient in describing specific shapes of Mössbauer spectra of nanostructured ferromagnetic alloys and represents a new approach to analysis of the spectra taking into consideration the interparticle interaction in not so complicated form which can be used by experimentators. This approach is actually an alternative way in order to evaluate the Mössbauer spectra of nanostructured ferromagnetic alloys without taking into consideration a rather wide and diverse distribution over the particle sizes.

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STRUCTURE AND CHEMICAL COMPOSITION OF RHODIUM CONTAINING NANOSTRUCTURES GROWN BY FOCUSED ELECTRON BEAM INDUCED DEPOSITION

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Focused Electron Beam Induced Deposition (FEBID) allows fabrication of three-dimensional micro- and nano-strucures on a wide range of substrates. The process is based on the decomposition of molecules of a pre-selected precursor compound by a focused electron beam. In recent decades EBID of several metals, namely Au, Cu, W and Pt, from different families of precursors has been achieved. The technique is already being applied for fabrication of supertips for Scanning Probe Microscopy and repair of masks and micro-opto-electronic device. FEBID usually lead to low metal content deposits, caused by co-deposition of elements (mainly carbon) present in the precursor and/or by the lack of selectivity of the process.

The metal content can be increased by substrate heating during deposition, by addition of oxygen or water vapor in the reaction chamber, by selecting the suitable precursor molecule. Recently, high metal content deposits have been grown by us at room temperature using Rh and Au trifluorophosphine chloro complexes as precursors.
In this work we focus on the production of Rh containing nanostructures, grown at room temperature from the inorganic precursor $[RhCl(PF_3)_2]_2$, and on their characterization by Transmission Electron Microscopy (TEM), Auger Electron Spectroscopy (AES) and Electron Energy Loss Spectroscopy (EELS).

TEM imaging showed that the deposits are made up of dark granular regions immersed in a matrix with lower average atomic number. Diffraction patterns showed that the dark regions (3 to 5 nm in diameter) correspond to face centered cubic Rh nanocrystals.

AES of several deposits revealed that the typical chemical composition, after sputter removal of the contamination layer, is: 60% Rh, 15 % P, 10% N, 10% O, 5% Cl. This corresponds to one of the highest metal content detected in FEBID structures.

Electron Energy Loss Spectroscopy (EELS), used for the first time to analyze FEBID structures, detected the presence in the deposits of the elements Rh, P, N, O and C. These measurements confirmed, with a non-distructive method, that the presence of C is limited to the contamination layer, while the other elements are contained in the deposit bulk. High resolution EELS mapping allowed to determine the distribution of the elements in the deposits with sub-10 nm resolution.

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P2 – 27

ELECTRONIC STATES AND OPTICAL TRANSITIONS PROPERTIES OF SILICON NANOCRYSTALS

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Semiconductor nanocrystals have received much attention lately because of the size-dependence of their physical and optical properties. The wavelength of light absorbed and emitted by a semiconductor nanocrystal can be tuned by varying the size of the crystal. As cluster size increases, the energy of the lowest optical transition decreases due to quantum effects, causing a red shift in optical absorption. This property has been used to develop light-emitting-diodes (LEDs) that can emit light in the blue- green range. The purpose of this work is to investigate the electronic states and optical transitions properties of silicon nanocrystals of varying sizes. As we are interested in describing the band-structure modifications around the gap, the minimum basis capable of describing an indirect band gap along the *x* direction is the sp^3s^* basis. The optical properties of Si wires are calculated from the electronic band structure obtained by means of an tight-binding Hamiltonian and supercell model, in which the wires of crystalline silicon are columns, in the direction [001], of square cross section with width from *a* to *7a*, where *a* is the lattice constant.

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NONLINEAR ABSORPTION OF GLASSES DOPED WITH PBS NANOCRYSTALS. APPLICATION FOR SATURABLE ABSORBERS IN LASERS

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Semiconductor nanocrystals suspended in various dielectric media have easily tunable absorption bands and show ultrafast dynamics of generated electron-hole pairs. That makes them attractive for application as nonlinear optical materials. In particular, PbS doped glasses have been utilized as saturable absorbers for mode locking of a Cr:forsterite [1], and Nd:YAG [2] lasers. Our recent study of the optical nonlinearities induced by picosecond light pulses revealed complexity of the relaxation processes, which are of importance for application of PbS doped glasses as saturable absorbers [3].

In this report we discuss the dynamics of the nonlinear optical absorption of PbS doped glasses in more details and analyze the peculiarities of the mode locking of Nd:YAG laser by using these saturable absorbers. The experimental study was performed by using a transient pump-probe absorption technique with 2 ps time resolution. The samples were excited by intense laser pulses with photon energies corresponding to different spectral positions in the lowest-energy or higher-energy absorption bands, and relaxation kinetics of nonlinear response was compared and analyzed. Both absorption bleaching and relaxation of this process were almost independent of the excitation quantum energy within the lowest energy band. However, photoexcitation into the higher absorption band caused a crucial modification of the optical nonlinearities and their relaxation dynamics. This indicates to different relaxation paths for high- and low-energy excitations. Relaxation of the two electron-hole pairs created by high-intensity laser pulses revealed collective electron-hole interaction due to strong spatial confinement in a PbS nanocrystal.

The investigations enabled us to develope a clearer picture of the formation and relaxation of optical nonlinearities, which is of importance in analyzing peculiarities of the mode locking of solid state lasers by PbS doped glasses.

P.T.Guerreiro, S.Ten, N.F.Borrelli, J.Butty, G.E.Jabbour, and N.Peyghambarian, Appl. Phys. Lett., V. 71, p. 1595 (1997).
A.M.Malyarevich, V.G.Savitski, P.V.Prokoshin, N.N.Posnov, and K.V.Yumashev, J. Opt. Soc.am., V.19, No.1, p. 28 (2002).
G.Tamulaitis, V.Gulbinas, G.Kodis, A.Dementjev, L.Valkunas, I.Motchalov, and H.Raaben, J.Appl. Phys., V. 88, No. 1, p. 178 (2000)

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P2 – 29

THEORETICAL STUDIES OF BINARY LIQUID TRANSITION-METAL ALLOYS

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A success in theoretical investigations of simple-metal alloys is connected mainly with the nearly-free-electron model applicable to a discription of electron-ion interactions. The situation for the transition metals is closer to the tight-binding picture than the nearly-free-electron scheme. The effort to calculate thermodynamic properties of a pure liquid transition metals was made in Ref. [1]. This study is based on the one of semi-empirical tight-binding models.

In the present study, the method of Ref. [1] is modified for calculations of thermodynamic properties of binary transition-metal liquid alloys. The free energy of mixing, excess entropy and heat of mixing are computed by means of suggested approach. Our numerical calculations are in a good agreement with experimental data.

1. Aryasetiawan F., Silbert M., Stott M. J., J.Phys. F: Met. Phys., 1986, v. 16, p. 1419-1428.

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P2 – 30

MODIFICATION OF TRANSPORT PROPERTIES OF POLYMER MEMBRANE BY ION IMPLANTATION

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We present an experimental study of the transport properties of the ion irradiated polypropylene (PP) polymer foils. The PP polymer samples were irradiated with O^{+7}, S^{+7}, F^{+5} and O^{+2} ions having the energy 10 keV/q with doses up to 10^{15}–10^{16} ions/cm^2. In these experiments the incident ions were produced using the ECR ion source. The transport properties (diffusivity) and changes of the chemical structure and wettability of ion implanted PP membranes were studied by diffusion current measurements over a wide range concentration of solute (ethanol) and a measurements of the infrared spectra (AFR-IF), differential scanning calorimetry (DSC) thermogrames, atom force microscopy (AFM) image and the contact-angles methods.

The results of the AFR-IR spectroscopy and AFM imaging show that ion implantation induce a substantial changes in chemical structure of polypropylene samples.

The implanted PP foils with given ions are characterised by variable degree of cristallinity of a polymeric system. The surface of membranes become more hydrophilic after implantation used ions. Also the histeresis in the contact-angle gives some indication about the surface roughness or composition. The behaviour of the PP modified membranes under implantation show greater permeability for diffusive solute.

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RESPONSE OF CLEAVAGE SURFACE OF ALKALI-HALIDE ON COMPLEX ACTION OF HEAT AND ELECTRIC FIELD

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Modifications of surface {100} of alkali-halide single-crystals under action on them to the constant electric field in the temperature range 293-1023 K were experimentally found. The modifications were exhibited in emerging on a researched surface of jelly-like spherical formations ("drops"). The experiments were carried out under the parallel-plate capacitor circuit. The sample was located between parallel electrodes. One edge of the crystal was reliably contacted with an electrode. There was an air gap ~0,1 mm between the opposite edge and the second electrode. The constant 400 V voltage was affixed to the electrodes of the capacitor.

The purpose of work consists in the definition of connection between electrical parameters (current density, electric field strength between a free surface of a sample and electrode, density of the surface-bound charge), temperature and the surface condition.

1. The dependence of a current density in a gap from temperature - j(T) carries exponential character. It is marked, that the magnitude of j grows faster in case of the positively charged surface. The dependence of the electric field strength in a gap from temperature - E(T) is defined. The approximation of experimental data's gives the following outcomes:

$$\begin{cases} E(T) = a_1 + b_1 T, \text{ for } T \le T_k \\ E(T) = E_0 + a_2 \cdot \exp(-(T - T_k)/b_2), \text{ for } T \ge T_k, \end{cases}$$

where a_1, b_1, a_2, b_2 - experimental values, and T_k - temperature boundary between intervals of impurity and intrinsic conduction of a researched material. For NaCl samples the dependence of the density of the surface-bound charge from temperature is $\sigma(T)$. It is marked, that the magnitude of σ for cases of positively charged surface is considerably more than with negatively one, though the general view of curves is similar. Most close empirical formula of an aspect approaches to experimental points:

$$\sigma(T) = A \cdot B \Big/ \left[4(T_{\max} - T)^2 + B^2\right],$$

where A and B - experimental values, T_{max} - temperature which with is observed a maximal value of σ.

2. The analysis of obtained dependences allows to judge about processes in superficial layers of crystal with action by both of the electric field and heat. Optimum temperature and current density calling the most active growth of "drops" were found. It is marked, that the current density begins noticeably to grow after temperature T_k, therefore dependence j(T) is stipulated by a diffusion of mobile ions of metal in direction of the field, it explains faster growth of magnitude j for cases of the positively charged surface. The various mechanisms of accumulation of the charge associated with positive and negative polarity. In the first case - surface is saturated by interstitial ions of metal. In second case, outflow them from a surface

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cause's destruction of a lattice at the expense of electrostatic forces. The presence of peak is explained by saturation of a surface by a charge and further recession of value σ by emission of ions from a surface and discharge in gas.

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CARBON NANO-PARTICLES PREPARED BY PLASMA-DUST METHOD

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Plasma assisted chemical vapor deposition (PA-CVD) technique was used to produce carbon nano-particles in dusty plasma condition, at increased gas pressure and lower electric field conditions. The negatively biased upper electrode levitates the forming carbon clusters, which grow in a spherical symmetrical way in the relatively large density of the ions of the plasma. The mobility of the growing cluster decreases as their mass increases. The spheres also attach to each other, but their concentration and mobility being low, results in a different structure. The connection of the first two spherical clusters is spherically symmetric, looking from the center of both. The connection of the third (and followings) is more complicated. The elongated double cluster have a cylindrical structure, its static electric field, its dynamical polarization field is stronger around its ends. The consequence is, that the connection of the third (and any further) attaching particle will prefer the end of the pair, a necklace-type chain will be formed. The further growth by attaching ions stabilizes the cluster-joints.

The dust, leaving the plasma covers the chamber wall, but a substantial amount of it reaches the electrically driven substrate an amorphous film forms also. These clusters contribute to the growth of the film. The cluster size can be controlled during the deposition process, and it is an interesting possibility to investigate the differences between cluster-systems of different mean sizes. The cluster systems were investigated by transmission electron microscopy (TEM), atomic force microscopy (AFM), Raman, infrared (IR) and photoluminescence (PL) spectroscopic methods.

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THE HIGH-FREQUENCY PROPERTIES OF QUASI-TWO-DIMENSIONAL CONDUCTOR FILM

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A high- frequency longitudinal acoustic wave, propagating along the normal to the layer of quasi-two-dimensional conductor film with depth d which is much smaller then the mean free path of the conductive charge carriers ($d << l$), is considered theoretically. The acoustic fields connected with both ordinary and anomalous acoustic wave show resonance behaviour for different frequencies of the external acoustic wave, which enables the above two waves to be studied separately in the quasi-two-dimensional conductor thin film. Some characteristic differences between high-frequency properties of the quasi-two-dimensional and three-dimensional isotropic conductive films were predicted.

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THE STUDY OF PHASE TRANSITIONS IN NEW CHIRAL HOMOLOGOUS SERIES AND BINARY MIXTURES OF SOME FERROELECTRIC LIQUID CRYSTAL

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The homologous series of ferroelectric liquid crystals S-(-)-4-(2-n-alkoxy-propionyloxy)biphenyl-4'-n-alkoxy-3,5-dimethyl-benzoate (DMn/m) derived from the O-substituted S-(-)-lactic acid, was investigated by optical microscopy and X-ray. The synthesis of this compounds was described earlier [1]. The phase behaviour of binary mixtures was investigated by optical method. It was established that the mesophase temperature range of the chiral smectic C (SmC^*) phase of binary mixtures has been broadened, though the phase remained monotropic, furthermore the chiral nematic (N^*) phase became enantiotropic, compared to the individual compaunds. Mixtures (BM1 and BM2) are composed of members of the DMn/m series with chiral chains differing from each odder by four carbon atoms in length (DM7/6, DM7/10 and DM10/8, DM10/12 respectively). Both exhibited enantiotropic SmC* phase, but the N* phase (in BM1) of the individual components disappeared. If the difference of the terminal chains was larger than four carbon atoms (e.g. mixture BM9 composed of DM7/5 and DM12/12) the SmC* phase remained monotropic.

According to the X-ray diffraction data obtained on non-oriented samples, we have identified an enantiotropic SmC^*, N* and blue phase in DM7/10. We have calculated two molecular parameters, the layer spacing in the SmC^* phase and the average intermolecular distances in the SmC^*, N* and isotropic phases. In the mixtures BM1 and BM2 the SmC^* phase was stabilized. We found an intercalated tail-to-tail packing of the molecules, resulting in the decrease of the layer spacing, and the increase of the intermolecular distances. In the mixture BM9 the layer spacing increased and the packing density of the molecules perpendicular to the long axes decreased.

Keywords: ferroelectric liquid crystal, phase transition, x-ray diffraction, molecular parameters.

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[1] A.Vajda, M.Kaspar, V.Hamplova, P.Vanek, K.Fodor-Csorba, and B.Lajos: *Mol.Cryst.Liq.Cryst.*, 351, 279-286 (2000).

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P2 – 35

POTENTIAL BARRIER HEIGHT DETERMINATION OF CUPROUS OXIDE SOLAR CELLS

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Polycristalline thin and uniform films of cuprous oxide were prepared by electrodeposition method on copper and transparent conducting glass coated with indium tin oxide or tin oxide. By depositing thin film of nickel or graphite paste, solar cells have been completed as back or front wall type cells. This paper reports determing of potential barrier height using capacitance - voltage measurement. The capacitance was measured as a function of reverse bias voltage at room temperature.

Keywords: Cuprous oxide, Electrodeposition, Solar cell, C-V characteristics

[1].B.P.Rai, Solar Cells, 25 (1988) 265-272
[2].L.Papadimitriou, N.A.Economu and Trivich, Solar cells, 3 (1981) 73
[3]. A.E.Rakhshani and J.Varghese, Solar Energ Materials,15,23,1987
[4].V.Georgieva, *Balkan Physics Letters, BPL*,Vol No1 pp 49-55 (1997)

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P2 – 36

ELASTIC SCATTERING OF ELECTRONS ON CONDUCTING POLYMERS

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Electron spectroscopies: AES, XPS are used for quantitative surface layer analysis of conducting polymers. The synthesis of conductive polymers (polyanilines, polyacetylenes, polythiophenes, undoped and doped by Pd etc.) has been described in [1]; they have been prepared in Warsaw. The evaluation of electron spectra is based on parameters of electron transport processes [2]. They are: the inelastic mean free path (IMFP) [3], the elastic and inelastic scattering cross-sections of electrons [2]. An cefficient method for their experimental determination applies elastic peak electron spectroscopy (EPES) [4], based on elastic backscattering of electrons. The elastic peak intensity $I_e(E,Z)$ is affected by atomic number Z, energy E and by the angular conditions of the electron spectrometer. The elastic peak exhibits fine structure: the recoil effect (shift and broadening of the peak) [5] and the surface excitation losses [6], characterized by SEP parameter. The elastic peak of compounds splits into their components, producing broadening [5]. The IMFP of various conducting polymers was measured with a HSA analyzer [1]. The energy range E = 0.2-5 keV was covered and high-energy resolution was applied [1]. The surface layer composition of samples was checked by in-situ XPS and XAES. The IMFPs were measured with Ni and Ag reference samples [1,3]. The experimental IMFPs of conducting polymers were confirmed with calculated data [1]. The SEP parameters were deduced from REELS spectra [6]. The inelastic scattering cross-sections have been determined from the REELS spectra using Tougaard's procedure [7]. Our procedure is based on reference samples polySi, amorphousGe and Ni, with defined values of SEP. The values of SEP for some conducting polymers were estimated.

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[1]. B. Lesiak et al. Appl. Surf. Sci. 174 (2000), Surf. Interface Anal.99 (2001) 614, Polish. J. Chemistry, 74 (2000) 203.
[2] W.S. Werner, Surf. Interface Anal. 31 (2001) 141.
[3] C. J. Powell et al. J Phys. Chem. Ref. Data, 28 (1999) 19.
[4] G. Gergely, Surf. Interface Anal 3 (1981) 201, Scanning 8 (1986) 203.
[5] A. Sulyok et al. Vacuum, 61 p107, 63, p371 (2001), 63 Surf. Interface Anal. 31 (2001) 1019
[6]. G. Gergely et al. Solid State Ionics, 141-142 (2001) 47
[7] S. Tougaard et al. Phys. Rev.B. 43 (1991) 1651

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DIELECTRIC AND VISCOUS PROPERTIES OF NEMAOGENIC 1-(4-TRANS-PROPYLCYCLOHEXYL)-2-(4-CYANOPHENYL)ETHANE

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This paper presents the results of measurements of the dynamic electric permittivity and the shear viscosity of freely flowing sample for 1-(4-trans-propylcyclohexyl)-2-(4-cyanophenyl)ethane-3CCPE.

The method of dielectric spectroscopy yields valuable information about the molecular arrangement, intermolecular interactions and dynamics of the liquid crystal molecules[1].

Experimental studies of the dielectric relaxation in the nematic and isotropic phases of this compound have been performed in the frequency range from 1 kHz to 100 MHz. From the temperature dependence of the dielectric relaxation time (corresponding to the molecular rotation around the short axis) and the shear viscosity [2], the strength of the nematic potential and the effective length of 3CCPE molecule (in isotropic phase), were estimated.

[1] Urban, S., Kedzierski, J., and Dabrowski, R., 2000, Z. Naturforsch., 55a, 449
[2] Jadzyn,J. and Czechowski, 2001, Phys. Rev. E, 64, 052702

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TRANSPORT PROPERTIES OF BI BASED NANOWIRES UNDER ELECTRON TOPOLOGICAL TRANSITIONS INDUCED BY STRETCH

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In the paper temperature dependences of resistance, thermopower, magnetoresistance and magnetothermopower of nanowires of Bi and its alloys obtained by the liquid phase casting in a glass coating are considered.

It is shown that absent compensation of different sign carrier fluxes caused by deformation and change of the surface scattering leads to significant change of thermopower, magnetothermopower, magnetoresistance. Experimental results are explained in the frames of a model taking into account change of frequency of carrier scattering by the sample surface in the magnetic field.

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COHERENT PHENOMENA IN A NORMAL CONDUCTOR WITH A SUPERCONDUCTING COATING

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The thermodynamic properties of a mesoscopic-size simply connected cylindrical normal metal with a superconducting coating are studied. It is accepted that a vector potential field can be varied inside the normal layer. The quasiparticles move ballistically through the normal metal and undergo the Andreev scattering by the off-diagonal potential. We find the spectrum of the Andreev levels and calculate the density of states (DOS) of the system. It is shown that the Andreev levels shift as the trapped flux changes inside the normal conductor. At a certain flux value they coincide with the Fermi level. A resonance spike in the DOS appears in this case. As the flux is increased, the DOS behaves as a stepwise function of the flux. The distance between the steps is equal to the superconducting flux quantum *hc/2e*.

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C_{60} NANOFILMS ON NI : THE PULSED LASER INDUCED DESORPTION C_{60}^+ PRODUCTION

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This communication [1] present studies of Pulsed Laser Induced Desorption for C_{60} UHV sublimed nanofilms on Ni (thickness=5, 10 and 20 nm). A pulsed Excimer laser (λ=308 nm, T(FWHM)=20 ns , repetition rate of 10Hz) or a pulsed Nd-Yag laser (λ=355 nm, T(FWHM)=30 ps , repetition rate of 10Hz) were used to illuminate the C_{60} nanofilm. The positive ions formed were mass analysed by Time of Flight Mass Spectrometry with reflectron geometry. Velocity distributions of the species produced are characterised by so-called "full-range" Maxwellian.

All spectra for C_{60}^+ production shows evidence of till three contributions. The way that we try to monitor the situation is through the Mach number, $M=u/v_s$, where u is the flow velocity and v_s is the sound velocity calculated directly from the value of the Temperature of the distribution obtained. The M value can help to monitor the efficiency of transfer of the energy that will take place already on gas phase regimen. The experimental data shows how C_{60} nanofilm pulsed laser desorption process is complex. In fact, at least, five tendencies of M versus absorbed irradiance are possible to be identified.

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PHOTOEXCITATION OF POLARONS AND BIPOLARONS IN CONJUGATED POLYMERS

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We study conjugated polymers in which two dimerization patterns are close to being degenerate, e.g. the butatrienic and acetylenic forms of polydiacetylene (PDA). A phase transition between these forms of PDA has been considered [1], hence one may control the deviation from degeneracy by changing temperature. We study sub-gap photoexcitaion which can produce either polarons or bipolarons as charge carriers; in the limit of degeneracy solitons are also possible [2,3]. Sub-gap photoexcitaion is possible by quantum tunneling of the conjugation pattern in a two-dimensional parameter space. We evaluate the photocurrent response which can measure efficiently the deviation from degeneracy and therefore clarify the possibility of a phase transition in PDA [1]. We also consider the dephasing process in which the charge carriers become incoherent and infrared activity associated with independent charges appears [4].

1. K. Kuriyama. H. Kikuchi and T. Kajiyama, Langmuir, 14, 1130 (1998).
2. R. Ball, W. P. Su and J. R. Schrieffer, J. de physique 44-C3, 429 (1983).
3. J. P. Sethna and S, Kivelson, Phys. Rev. B 26, 3513 (1982).
4. B. Horovitz, Solid State Commun. 41, 729 (1982).

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P2 – 42

FORMATION OF SEMICONDUCTOR CLUSTERS IN ZEOLITES

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In this work we explore the use of some zeolite host matrices(mordenite, clinoptilolite) into which the CdS and ZnS clusters are created in situ to impose crystalline order and physical constraint upon the included semiconductor guests. The zeolites in their sodium cation form were first ion-exchanged to the cadmium or zinc form, and than treated with 1 molar solution Na_2S. The atomic absorption method evidenced a S/Cd ratio of 3.51and a S/Zn ratio of 2.72. Absorption spectra of zeolite-encapsulated CdS and ZnS clusters are blue-shifted from the bulk edge by 50 to 100 nm. The absorption edge changes as a function of cluster-cluster contact distance in the zeolite(from 470 nm, for CdS-CLI, to 450nm, for CdS-MOR). The room-temperature photoluminescence spectra of CdS doped zeolites are characterized by broad-band emission consisting of two main bands at 440 nm and 500 nm. The main band at 580 nm observed at 78K has been atributed to Cd atoms, products of photochemistry. The blue band at 450-470 nm was atributed to the donor-acceptor pair transition in which the acceptor is related to the Zn^{2+} vacancy. The red deplasement of ZnS emission spectrum, at 78K, was negligible, suggesting a stronger interaction with the zeolite lattice and a better stability. Our results, obtained on CdS and ZnS clusters encapsulated in mordenite and clinoptilolite, showed that the interaction between the discrete clusters is stronger in clinoptilolite due to the 2-dimensional channel system.

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ENERGY ABSORPTION IN ALUMINUM FOAMS

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Recently there has been a remarkable increase in interest in metal foams especially using Al-based foams for lightweight structural components in energy absorption systems for protection from impacts. The essence of protective packaging is to absorb as much energy as possible while keeping the packaged object below the force limit, which will cause damage or injury.

Cellular materials (like aluminum foams, polymer foams) exhibit a characteristic compressive stress-strain curve with three stages. At small strains (<1-2%) the foams deform in linear elastic way; there is then a plateau of deformation (<60-80%) at almost constant stress and finally there is a region of densification as the cell walls crush together. Due to this long plateau foams are suitable for absorbing energy without exceeding a given stress limit.

To characterize the energy absorption features of aluminum foams compression and indentation tests were performed on differently fabricated foams by powder metallurgy, replication from salt precursors and by adding blowing agent to molten Al. The effects of structural parameters of foams on energy absorption properties were also investigated.

Relying on a theoretical description of the deformation of foams an optimum density range for energy absorption was found and confirmed by compression measurements. The changes in the energy absorption capacity during both compression and indentation were also described.

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ABSORPTION SPECTRA OF $[NH_3(C_3H_7)]_2CuCl_4$ CRYSTALS

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The optical properties of A_2CuX_4, where A – organic cation, X – halogen, have been investigated [1]. The $[NH_3(C_3H_7)]_2CuC1_4$ crystals is very interesting due to its structure, because the $NH_3(C_3H_7)^+$ propylamine cation exists in two izomorphous forms. The first of them, named izopropylamine (IPA), is connected with isomer $(CH_3)_2CHNH_3$ (have not been investigated yet). The $[NH_3(C_3H_7)]_2CuC1_4$ crystals with other izomorphous form of cation, named n-propylamine (in abbreviation n-PA) have been grown from water solution. The absorption spectra in the visible region of this crystal has been measured using Carl-Zeiss Jena spectrometer. An influence of the temperature on the shape of the absorption spectra has been studied in the region 300 – 450K. The temperature research suggests the existence of four structural phases in the temperature region 378 – 423K, marked □, □, □, □. The effect of thermooptic memory in optical spectra has been also observed. Full understanding the phase transitions mechanism in $[NH_3(C_3H_7)]_2CuC1_4$ needs further investigations.

[1] Połowinko I., Kałuża S., Optyczne właściwości faz niewspółmiernych kryształów typu A_2MX_4, Edited by PSk, Kielce 1998 (in Polish).

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THE CRYSTALS WITH INCOMMENSURATE PHASES IN DIGITAL RECORDING

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Investigations of the ferroelectric crystals of A_2MX_4 and AMX_3 type with incommensurate phases are very interesting both from a scientific and practical point of view. Some aspects of using of these crystals in digital recording are discussed [1]. Special attention is paid to technological aspects of processing of digital recording.

Crystals with incommensurate phases can be carriers of information because show the temperature hysteresis of birefringence in area of the incommensurate phase. Impulses of laser light has been used for coding of information. The laser beam heated the local points of the crystal plate. Due to this effect local value of birefringence has been changed. Different values of birefringence for processes of cooling and heating for the areas locally lighted up and not lighted up with impulse of the laser light have been observed. It is equivalent a recording of information in the binary code.

The phenomenon of thermal hysteresis of absorption coefficient for information coding in the same crystals is also discussed. The $[N(CH_3)_4]_2CuCl_4$ crystal prepared from water solution has been chosen for further investigation. The temperature dependence of coefficient of absorption in working range of temperature was measured. Obtained results confirm occurrence of hysteresis phenomena of absorption coefficient in the region of phase transition between incommensurate phase and ferroelastic phase. This fact confirms an utility this material for coding of information.

[1] M. Suchańska, S. Kałuża, S. Leśniewski, „Some aspects of using of the A_2BX_4 crystals with incommensurate phases in digital recording", Opto-electronics Review 9 (3), 2001, p.353-355

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STUDY OF THE COORDINATION PATTERNS OF TIN(IV)-CUPFERRONATES WITH MÖSSBAUER SPECTROSCOPY

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Compounds consisting organotin cations and cupferronate ligands are studied. The cupferronate forms complexes with most of the metal ions and it generally coordinates as a bidentate ligand forming chelating coordination patterns. However in the studied complexes, corresponding to the general formula $[R_nSncupf_{4-n}]$ (R: CH_3 or C_6H_5), it also forms bridging bonding patterns, which was only found in one manganese complex. The surprisingly various structures (the different sort of coordinating modes of the anion and the variation of the coordination number of tin between 5 and 8) make these compounds very interesting for structural studies. For determining their structure in solution, we carried out Mössbauer spectroscopy measurements on the solid compounds and their quickly frozen solution. Besides the independent NMR-spectroscopy data, when it was necessary, these experiments were assisted by model-calculations and FTIR-spectroscopy investigations. The Mössbaur spectroscopy revealed to be a useful method to follow reactions: as well as observing a major structural transformation, we found proofs of an elusive chemical reaction.

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EXCITED STATE DYNAMICS OF INDANDIONE –1,3 PYRIDINIUM BETAINE DERIVATIVES IN SOLUTIONS

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Organic molecules containing electron-donor and electron-acceptor fragments attract much attention as model systems for investigation of the charge transfer reaction. Solids built by polar molecules often show significant photocurrent and well-pronounced non-linear optical effects. The indandione –1,3 pyridinium betaine (IPB) derivatives are typical representatives of this class molecules. They posses large dipole moment of about 4-5 D in a ground state, which changes its sign and becomes equal to –3.6 D in the excited state. So large variation in the dipole moment makes them attractive for application as active elements in molecular optoelectronic devices. Excited state properties and dynamics are of particular importance for such kind of applications. Our previous investigations showed that despite of relative simplicity of the IPB molecules their optical properties and excited state dynamics are not trivial.

In this report we discuss the excited state dynamics of IPB and 4N-IPB molecules in solutions. It was already reported that IPB molecules in solutions show weak fluorescence and posses very large Stokes shift of the fluorescence band. Here we investigate the fluorescence properties and the excited state dynamics by means of picosecond transient absorption method. No significant difference between the relaxation mechanisms of the two molecules was observed, except that the excited state relaxation of 4N-IPB is slightly faster. Both molecules show a fast and complex excited state relaxation where at least three excited states are involved. The Franc-Condon state which is formed during the light quantum absorption transfers into a weakly fluorescent state on a femtosecond time scale. The third excited state which also forms on a subpicosecond time scale relaxed during tens of picoseconds. Ultrafast molecule twisting is evidently responsible for the weakly fluorescenct state formation, while low energy n-π^* states are involved in subsequent excited state relaxation.

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FERMI-LIQUID ELECTROMAGNETIC MODES IN LAYERED CONDUCTORS

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Propagation of weakly damped electromagnetic waves in a Fermi liquid of conduction electrons has been studied theoretically. It is shown that the specifics of the quasi-two-dimensional electron energy spectrum in organic conductors with layered structure gives rise to peculiar Fermi liquid modes, which are absent in a gas of charge carriers. These collective excitations exist at relatively low frequencies and can be observed easily. Due to the correlation effects there are windows of transparency of the layered conductor for two electromagnetic waves with different polarization even at low intensity of the Fermi-liquid interaction. The presence of two waves is connected with the fact that the external magnetic field lifts degeneracy of the spectrum of the electromagnetic excitations.

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COMPARISON OF THE PORTEVIN - LE CHATELIER PLASTIC INSTABILITIES IN DIFFERENT DEFORMATION GEOMETRIES

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The Portevin - Le Chatelier (PLC) plastic instabilities occur in solid solutions as a consequence of the solute atom - dislocation interaction. On a macroscopic scale, the instability is characterized by a spatio-temporal localization of plastic deformation, i.e. by the appearance of high strain rate deformation bands (PLC bands) in the plastically deformed volume. The localization of the deformation requires highly collective dislocation motion, for which both the dislocation - solute atom and dislocation - dislocation interaction is essential.

PLC plastic instabilities were investigated by depth sensing indentation method in load control. Quantitative comparison of the different behavior of the instability was made between the indentation methods and the conventional uniaxial tension or compression methods. Parameters of the PLC instability, such as the depth of the DSA and the critical strain rates can be determined from the depth sensing indentation test. Additionally, analyzing the slow regime of the instability steps, changing of the volume of instability can be traced during an indentation test.

The aim of the present investigation is to establish the quantitative interpretation of the PLC effect in depth sensing indentation test, to exploit further advantages of the investigation PLC effect by indentation. From the observation of PLC instabilities conclusions can be drawn as to the intrinsic parameters of the indentation tests, like the role of gradient effects in indentation tests, or on the other hand the depth sensing indentation method may give additional information to the theory of the PLC instabilities by the local investigation of micron or even nano size plastic volumes.

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MEAN FIELD THEORY OF MOLECULAR MAGNETS

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Molecular magnets can be characterized theoretically by a Hamiltonian containing the components of a single large spin. Most interpretations of experiments and almost all theoretical approaches use a Hamiltonian of this type to deduce the properties of the molecular magnet. There is however an alternative to this approach. Instead of using a single spin with a large z-component, one can introduce many spins with length 1/2 and derive a Hamiltonian with exactly the same energy-spectrum. The most important difference between the two models comes from the density of states. In the large single spin model the density of states is uniform, while in the many spin model the density of states contains combinatorial factors. These factors and hence the density of states strongly influence the temperature dependence of the thermodynamical quantities such as the magnetization, the susceptibility and the specific heat.

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MONTE CARLO SIMULATION OF THE FORMATION AND COARSENING OF ANTIFERROMAGNETIC DOMAINS IN TRI- AND MULTILAYERS

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A simple 2D Monte Carlo model describes primary antiferromagnetic domain formation and secondary domain coarsening in strongly-coupled AF multilayers (ML) of fourfold in-plane magnetocrystalline anisotropy. In these MLs □m-size patch domains form when the external magnetic field is decreased to zero from full saturation. Different easy and hard axis field scenarios lead to different spin-flop and corresponding domain coarsening phenomena.

The same lateral variation of magnetic and spacer thickness gives rise to short and long correlation lengths of the saturation field H_S and the anisotropy energy, respectively. The H_S - distribution is modeled by randomly generated and correlated numbers of correlation length ($\chi(H_S)$) on a square lattice. Color pixels on the same lattice represent the top layer magnetization of areas of suitable resolution for domain description. AF domains (single color patches) are allowed to form on decreasing field from saturation (monocolor state) by nearest neighbor rules. The resulting domain correlation length, $\chi \approx \chi(H_S)$.

By applying a long-correlation smoothing and realistic spin-flop rules a spectacular "cartoon" of the domain coarsening is generated. Solely 180º-walls are obtained for easy axis magnetization. In the hard-axis case 180º and 90º-walls are formed in the secondary domain state in fairly good agreement with MOKE microscope patterns on Fe/Cr trilayers.

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ON THE STRUCTURE AND MORPHOLOGY OF TITANIUM OXIDE THIN FILMS

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The aim of this paper was to investigate how the morphology and the structure of titanium oxide thin films depend on some deposition parameters. Substrate nature, substrate temperature, deposition time, or impurity doping change the proportion of anatase and rutile phase, increase or decrease the grain sizes and also the nodules observed at the surface of titanium oxide thin films. An anatase/rutile structure is obtained for heated substrates less than 400°C. Samples obtained at a substrate temperature of 450°C are rutile. For samples deposited onto glass substrates, Ce or Nb addition (0.4at.% and 0.35at.% respectively) determines a change in the structure, from rutile to anatase, while Fe (1at.%) doping determines a phase transformation from anatase to rutile. The ratio anatase/rutile varies signficantly for thin films deposited on the same deposition run onto glass substrates and onto glass covered with ITO substrates. The size of the nodules observed at the surface increase from 65nm to 150nm with the increase of the thickness from 280nm to 850nm.

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STRUCTURE AND ELECTRO-MAGNETIC PROPERTIES OF INTERCALATED CARBON NANOTUBES

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The geometrical structure, electrical and magnetic properties of semiconductor/metallic single-walled carbon nanotubes (SWCNT) and their joints under the intercalation of cobalt and its derivatives were studied in detail using the molecular-dynamics calculations [1]. In particular, the different stable structures of intercalated SWCNT were found depending on the internal and inter-tube infilling. The electrical resistance, thermoelectric voltage and magnetic susceptibility were determined and compared with data obtained for the pure SWCNT [2].

[1] Yu.I. Prylutskyy, S.S. Durov, O.V. Ogloblya et al., Comput. Mat.Sci., 2000, 17, 352.
[2] M.S. Dresselhause, G. Dresselhause, and P.C. Eklund, Science of Fullerenes and Carbon Nanotubes, Academic Press, New York, 1996.

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ELECTRON-BEAM-INDUCED-CURRENT (EBIC) FOR THE CHARACTERIZATION OF PHOTOVOLTAIC DEVICES

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EBIC and CL study of defects in strain balanced InGaAs/InGaAs photovoltaic cells are very important and have interest in structures of photovoltaic devices (PV). Strain-balanced heterostructures have gained widespread interest particularly in association with virtual substrates, to prevent plastic relaxation and misfit dislocation generation in the active region of strained semiconductor devices like lasers and solar cells. In fact, the combination of strain-balancing with the use of a virtual substrate makes it possible to obtain a wider range of epitaxial heterostructures, most of the dislocations being confined where their impact on the device performance is negligible. Recently strain balanced $In_xGa_{1-x}As$ MQW p-i-n structures were proposed as a new approach to extend the absorption range of high efficiency photovoltaic (PV) devices towards the near infrared. Although this solution has been proved to be successful we have found that in certain conditions a small local perturbation of the crystalline structure may result in catastrophic collapse of the MQW with the nucleation effect associated with strong non-radiative recombination centers. In This work we used EBIC and Cathodoluminescence (CL) and Atomic Force Microscopy (AFM) to investigate the nature of these defects and to get some hints about the mechanism of their formation.

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OFF-SPECULAR SYNCHROTRON MÖSSBAUER AND POLARISED NEUTRON REFLECTOMETRY IN STUDYING DOMAIN STRUCTURE OF ANTIFERROMAGNETIC MULTILAYERS

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Specular reflectometric methods have been known to probe the plane-perpendicular component q_z of the scattering vector in a stratified system thereby revealing its (possibly periodic) depth profile. The off-specular (diffuse) reflectivity probes the in-plane component q_x of the scattering vector and, consequently, reveals the in-plane correlation length of the scattering amplitude. We used off-specular synchrotron Mössbauer reflectometry (SMR) and polarised neutron reflectometry (PNR) to study the in-plane correlation length of the magnetisation direction in an antiferromagnetically (AF) coupled multilayer. The q_x-scan width at the AF Bragg-peak (i.e., at fixed q_z) is inversely proportional to the size of the AF domains. Using off-specular SMR a surprising magnetic-field-history dependence of the AF-domain size in a coupled Fe/Cr superlattice with fourfold magnetocrystalline anisotropy was revealed. This result was confirmed with off-specular PNR.

The MgO(001)/[^{57}Fe(2.6 nm)/Cr(1.3 nm)]$_{20}$ superlattice was prepared with molecular beam epitaxy technique. Sub-micrometer-size primary domains were formed in the sample at room temperature as the external field was decreased from well above the apparent saturation field of the AF-coupled Fe layers of about 0.9 T. On decreasing the field to zero, a spontaneous, coercivity-limited growth of the domains ("ripening") resulted in micrometer size domains. When a small field of about 14 mT along the layer magnetisations induced a spin-flop transition, a secondary domain state with majority large and minority small domains was created ("coarsening"). The large domains were at least ten times bigger than the small ones.

The AF-domain-size distribution was found to reproducibly depend on the magnetic field history. The condition for domain coarsening in AF multilayers is the equilibrium of the external field energy with the magnetocrystalline anisotropy energy rather than with the domain wall energy. The spin-flop-induced domain coarsening is an explosion-like growth of the domain size, not associated with long-range domain-wall motion and, consequently, not limited by coercivity.

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EFFECTS OF SI SUBSTITUTION ON THE INTERMETALLIC Sm_2Fe_{17} COMPOUND

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The nanocrystalline $Sm_2Fe_{17-x}Si_x$ intermetallic compounds obtained by mechanical alloying crystallise in the rhombohedral Th_2Zn_{17}-type structure. The lattice constants decrease when increasing the silicon content. The Rietveld analysis shows that Si occupies preferentially the *18h* sites. Magnetic measurements performed at 4.2 K in fields up to 9 T show a small increase in the iron moment per iron atom with increasing Si substitution.

The Curie temperatures are also higher when increasing *x*. The ^{57}Fe Mössbauer spectra were analysed with the Si distribution determined from X-ray results in correlation with the Wigner–Seitz volumes.

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BACKSCATTERING ELECTRON SPECTRA SIMULATION FOR Si AND Ge

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Different methods of electron spectroscopy (AES, XPS, EPES, REELS) play important role in modern technology. For precise interpretation of their results a description of electron transport is needed. Several methods (numerical solution of Bolzmann equation, Tougaard theory, Monte Carlo simulation, etc.) are available. These methods, however, are generally not able to deal with inhomogeneous samples. Filling the gap we developed a program based on direct Monte Carlo simulation method, which is capable of describing electron transport in samples with in-depth inhomogenity in the range of 0.1-10 keV primary electron energy.

The elastic peaks (EPES) and 50 eV below the elastic peak (REELS) were measured with two different electron spectrometers varying the primary energy between 0.2-5 keV on Si and Ge. Our program was applied to simulate the measured elastic peak and loss spectra. During the transport the electrons suffer elastic and inelastic scattering events which are assumed to be independent in our program. Similarily, surface and bulk energy losses are treated also independently. We take differential cross-section data from NIST database to describe elastic collisions and used our own bulk- and surface energy loss functions for inelastic scattering events. The energy loss is determined by the dielectric function which is however might be different from bulk one in the surface close region. Thus we have to find a loss function by trial and error method. The loss function extends from 0 to the primary energy. It is well-known, however, that the majority of losses occurs in the low energy region (<50eV). Since we want to fit the measured curve up to 50 eV and the sum (not the shape) of the remainder part of the loss function is considered. Constructing this part of the energy loss functions it is sufficient to choose single Lorentzian type distribution functions for Si and Ge, since in these materials the dominant loss is plasmon excitation. The intensities of energy loss functions was determined according to the IMFP values taken from literature. Similar method is applied for choosing the surface loss function.

For all the measured spectra calculations were carried out. The simulated spectra at and above 500 eV agreed well with the measurements, while at lower energies the agreement was acceptable. Differences between the simulated and measured spectra are discussed.

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STRUCTURE AND MAGNETIC PROPERTIES OF TWO- AND THREE-DIMENSIONAL MOLECULE-BASED MAGNETS (cat)[$M^{II}M^{III}(C_2O_4)_3$]

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Ability of oxalate anion $(C_2O_4)^{2-}$ to form bridging bonds between transition metal ions has allowed to design new molecular ferro- and ferrimagnets of various dimensionality with the general formula $(cat)^+[M^{II}M^{III}(C_2O_4)_3]^-$. The symmetry of organic cations $(cat)^+$ define the dimensionality of structure. In particular, tertiary ammonium cations forming two dimensional honeycomb structures indirectly influence magnetic properties by a variation of interlayer distances and change of local symmetry at magnetic centres. Racemic or resolved enantiomeric forms of starting for synthesis building units $[M^{III}(C_2O_4)_3]^{3-}$ results in formation of structures with various mutual packing of $[M^{II}M^{III}(C_2O_4)_3]^-$ layers the interaction between which determines the long-range magnetic order. On the other hand, the use of templating cations with helical chirality (e.g. (cat) = $[Ru(bpy)_2ppy]^+$) results in three-dimensional optically active compounds $(cat)^+[M^{II}M^{III}(C_2O_4)_3]^-$

For different types of $[M^{II}M^{III}(C_2O_4)_3]^-$ networks the influence of dimensionality, local symmetry and chirality of metal centers on magnetic properties have been studied by means of SQUID magnetometry and Mossbauer spectroscopy. Unusual temperature dependent magnetic relaxation phenomena below T_N was observed for both 2D and 3D compounds. These were interpreted as originating from quite different sources: low-frequency spin-wave exitations characteristic for 2D planar magnets and local site anisotropy axes alteration in 3D analog.

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VARIATION OF CONDUCTION MECHANISM IN THIN RF SPUTTERED TA_2O_5 FILMS AFTER SHORT TERM CONSTANT CURRENT STRESS

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Thin RF sputtered Ta_2O_5 films (~27nm) were obtained as insulating films in MOS structures. Their equivalent thickness is around 6 nm. The substrate was p-Si (15-17 Ωm), and the gate electrode aluminium. Their *I-V* (for leakage currents) and quasistatic *C-V* characteristics (for determining dielectric constant and measuring oxide charges and interface states) were measured with HP 4140A picoammeter.

Afterwards the MOS structures were subjected to constant-current stress (CCS) with different densities of current injected (0,05;0,1;0,15;0,2;0,25A/cm^2) for short time measurement (2,5 and 6 s) with both gate polarities. *U-t* measurements were done with HP3245A universal source and HP3458A system multimeter. Stress induced leakage currents (SILC) were measured after the degradation and were compared to the leakage currents before CCS.

The behavior of the SILCs and the change of q-*C-V* characteristics after the degradation confirmed the variations with time of gate voltage necessary to maintain the injected current density through the oxide i.e. weather the *U-t* curve was at first (decreasing of the field because of trapping the positive charge by existing traps before the stress), second (increasing the field connected with electron capturing) or third stage of evolution (slow increasing of the concentration of the positive charges connected to fulfilling the traps and forming new ones).

The conduction mechanisms were also investigated in terms of Schotky emission, Pool-Frenkel mechanism and Fowler-Nordheim tunneling. Initially, CCS normal Poole-Frenkel mechanism dominates in the oxide at medium fields (1,3-4,5V) no matter the deposition temperature or annealing steps and after the degradation appeared modified Poole-Frenkel with different compensation factors. After long term degradation conduction mechanism goes back to Poole-Frenkel.

The change of barrier height is calculated from the PF slopes. The barrier height is decreasing after CCS with 0,125 C/cm^2, from 1,2 to 0,83 eV (filling of hole traps), than increasing to 0,93 eV for stressing with 0,25 C/cm^2, and to 1,01 eV for 1 C/cm^2 (concentration of electrons at the interface is higher and initiates the increasing of the barrier height).

This results prove that Ta_2O_5 films can replace SiO_2 for 256 Mbit and 1 Gbit DRAM application.

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RAYLEIGH LIGHT SCATTERING BY LARGE-SCALE INHOMOGENETIES IN FILLED LIQUID CRYSTALS

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Nematic liquid crystals (LCs) doped with a low concentration of small colloidal particles, now known as filled LCs, scatter light very strongly. The strong scattering is due to large number of director field inhomogeneities around the particles.The contribution of the particles themselves to the light scattering is small due to their small relative volume and thus can be neglected. When an external permanent electric field is imposed on a filled LC cell, the director field distortions decrease, and this leads to a decrease in the light scattering. The cell becomes transparent. As a result of this effect the filled LCs have great potential for display applications and for use in other optoelectronic devices. Earlier we have considered the light scattering cross-sections in filled LCs in the case of small director inhomogeneities with characteristic size $R_{ch} < \lambda$, where λ is the wavelength of light. In this report we study the opposite case when $R_{ch} > \lambda$. This will be true either for large particles or when the director anchoring on the particle surface is sufficiently strong to lead to the formation of a disclination structure near the particle. In this case to treat the light scattering we used the so-called anomalous-diffraction approach.

Our principal findings are that: (a) for a so-called “dipole” director configuration around the particle, the light scattering is predicted to be approximately two orders of value stronger than for a “Saturn ring” configuration; (b) incident light polarized parallel to the scattering plane gives rise to a stronger scattered angular dependence than light polarized perpendicular to it; (c) when the inclusions are cylindrical, the light scattering is relatively stronger at low scattering angles than when the inclusions are spherical; (d) for a particle network, the nature of the network domain orientational distribution influences the intensity of light scattering, but has little effect on its angular dependence.

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ROLE OF ACCOMPANYING TWINNING IN DESTRUCTION SINGLE– AND POLYCRYSTALLINE BCC-ALLOY FE + 3,25 % SI

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The physical laws of initiation and formation of the accompanying twins and their influence on character of movement of a crack are investigated a little. In the present work the comparative tests on twinning, accompanying destruction of a bcc-alloy Fe + 3,25%Si single- and polycrystalline samples are carried out, and also some laws of formation and occurence of the accompanying twins in the temperature range of 77-473 K are investigated at various rates of deformation.

It was found that at dynamic stretching of single crystals samples in the direction [001] the twins of systems (112) and $(\bar{1}\,\bar{1}2)$ (screw orientation) along the edge of a crack were arisen. The twins of other possible systems along the edge of destruction were arisen in places of unstable growth of a crack.

Accompanying twinning at the stretching in the direction $[\bar{1}10]$ was observed only in the range of low temperatures. Thus along the route of destruction the mass initiation of the twins (112) and $(\bar{1}\,\bar{1}2)$ oriented parallely a stretching axis was marked.

During the destruction of polycrystals the main feature of attendant twinning together with the twins of screw orientation (112) and $(\bar{1}\,\bar{1}2)$ is the mass initiation of the twins of systems $(\bar{1}12)$ and $(1\,\bar{1}2)$ (edge orientation) due to variety of crystallographic orientations of grains.

The contribution of twinning in general relative deformation of single- and polycrystalline samples is evaluated. It is revealed, that temperature is fragile - viscous transition of polycrystalline samples less, than at monocrystal. It was found that the twinning was not practically observed in the grains the diameter of which did not exceed 0,1 mm. It was concluded that the quasi-brittle fracture shouldn't be connected with the twinning at specific modes of test in polycrystals with the size of a grain less than 0,1 mm. It is marked, that for single- and polycrystalline samples of dependence of number of the twins from temperature have maxima for all rates of deformation. These maxima are displaced in the direction of the large temperatures and numbers of the twins.

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BEHAVIOUR OF DISLOCATIONS AT THE CRACKS TIP CLEAVAGE FROM EXPOSURE TO THE ELECTROMAGNETIC RADIATION

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The destruction of crystals is accompanied by plastic deformation, its intensity and degree of localization depends on a velocity of crack propagation. At stopping of a crack in alkali-halide crystals the plastic zones are formed, their structure is determined by a type of a destroying crack, geometry of a sample, properties of a material. It is known that in such crystals spontaneous and artificial healing of cracks possibly.

The purpose of this paper was to investigate experimentally the influence of electromagnetic radiation on processes of stress relaxation and healing of crack tip in alkali-halide.

The behaviour of dislocations at tips of cracks will depend from a relation of stresses.

The plastic flow in the tip of a stopped crack in LiF single crystal was investigated by numerical modelling. Two stages of dislocation structure formation in the tip of crack were discussed. The first stage is the formation of gliding lines in the moment of crack stop. The second is their evolution and partial crack healing. It was shown, that in condition of unloading a few dislocations moved out of crystal on the crack plane under affect of mutual repel and forces of reflection. As a result of the process the dislocation density is maximal at some distance from the crack tip. There is a dislocation free area nearly the crack tip.

It was experimentally found, that electromagnetic radiation changed dislocation structure at tip of the crack. The summary density of dislocations was lowered. The healing at the crack tip was observed. Electromagnetic radiation causes decreasing of mechanical stresses in tip of the crack of a reversible motion of dislocations and partial healing of the tip. The exponential dependence of dislocation density both from temperature and from time of lighting was determined. The intensity of healing and relaxation of stresses depends on material and spectrum of electromagnetic radiation. The processes of healing and stress relaxation depend on intensity of electromagnetic radiation. The greatest effect is observed at action of a X-rays.

The influence of small doses X-ray radiation on processes of healing microcrack was investigated. The action X-ray radiation results in stress relaxation in tip of cracks for account a reversible motion of dislocations was established. The intensity of healing and stress relaxation depends from a wave of length of a X-rays. The effect of healing microcrack was incremented at diminution a wave of length. The mechanisms of stress relaxation and healing resulted from X-Ray radiation were discussed.

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MAGNETIC FIELD INDUCED WIGNER SOLID IN 2DEG IN INGAAS/INP HETEROSTRUCTURES

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In 1934, the Hungarian born physicist Jenő (Eugene) Wigner predicted that the electron gas in a conductor would crystallize, when the Coulomb energy dominated the kinetic energy of the electrons. This electron solid, named after Wigner, eluded experimental observation for a long time. Only with the emergence of the physics of two-dimensional electron systems in the past twenty years, could the Wigner solidification be observed at first in the electrons on the surface of liquid helium, then in the two-dimensional electron gas (2DEG) in semiconductor heterostructures.

The formation of the electron solid is governed by the ratio of the kinetic-to-Coulomb interaction energy of the electrons. An intense magnetic field, which quenches the kinetic energy of electrons, greatly enhances this process, and leads to the formation of the magnetically induced Wigner solid (MIWS). The Wigner crystal will be pinned by the impurities or by the disorder, so the system is insualting. In sufficiently high electric field the electron solid can be depinned (analogously to the case of a charge density wave), and electrical conduction emerges. The solid can also be "melted" by increasing the temperature.

Here we review results on the MIWS in InGaAs/InP with low 2DEG densitym($n_S < 2x10^{11}$ cm^{-2}). Due to the inherent alloy disorder in the InGaAs layer the disorder potential is much greater than in AlGaAs/GaAs heterostructures. In the InGaAs/InP system, the Coulomb potential and the disorder potential can be of the same magnitude, which might lead to a more complex behaviour of the 2DEG.

In magnetic fields up to 23 Tesla down to 40 mK temperature an exponentially divergent resistivity with increasing magnetic field, transition from non-activated to activated transport, and strong non-linearity in the current-voltage characteristics with threshold phenomena were observed, all below a critical Landau level filling factor $\nu = n_S h/eB = 0.35\text{-}0.45$. In low disorder AlGaAs/GaAs all these features have previously been treated as an evidence for the formation of MIWS. Our results indicate the possibility of formation of MIWS in 2DEG in the case of strong disorder too. A new model is proposed to describe the effects of the disorder potential, and we conclude that ordered electron distribution can be realized in these structures despite strong disorder.

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ANALYSIS OF STRUCTURE OF ISOTROPHIC POLYVINILTRIMETHYLSILANE BY CALCULATION METHODS

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It is a difficult problem to identify structure of non-crystalline system. The problem is more difficult for high-molecular polymers. The determination of experimental radial distribution function (ERDF) is one of calculation methods for structural analysis. The method is used successfully for analysis of different compounds. At the same time structural organization often can't be found on the base of another methods. The results of the calculations (made on the base of experimental radial distribution function) depend on both qualitative X-ray data and correct normalization of original experimental curve.

The material used in the present work is polyviniltrimethylsilane (PVTMS) – a well-investigated polymer. It is established, that during heating and stretching a part of macro-chains of this polymer is packed into hexagonal lattice with a=1,13 nm, with conformation disordering (c≈0.56 nm). There are few diffusive maxims with lattice half – width on X-ray diffractogram of initial isotropic sample. The sample has increased structural organization than true amorphous.

For calculation used PVTMS in form of isotropic film. X – ray investigations are made by diffractometer DRON – 2. The calculations are made on the base of computer technologies.

On the base of the calculations it is established, that in initial polymer average distances among molecules are 1.18 nm and inter-chain period is about 0.53 nm. These parameters are close to analogous experimental parameters (see above). It is explained by formation of columnar mesophase during thermal treatment and stretching. Under external influences the conformation changes take place, it influences on average inter-chain periods. The conformation disordering may be explained by the supposition, that not all macro-molecular chains are changed conformationally and the changes may vary.

The obtained results were checked by decision of inverse task – modeling of diffractometrical curve on the base of the most probable conformation and obtained with help of ERDF calculated data. This calculation is made on the base of equation of Debye, considering both disperse properties of atoms and distances among atoms. As a result, error in positions of diffusive maxims doesn't exceed 7%. It proves authenticity of the results obtained with help of ERDF.

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ABSORPTION SPECTRA FOR C_{60} FULLERENE WATER SOLUTION

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The structure of C_{60} fullerene water solution (C_{60}FWS) was studied in detail in dependence on the pure C_{60} molecules concentration (0.1, 0.2 and 0.4 mg/ml). In particular, the UV-VIS absorption spectra obtained in the wavelength (200-700) nm range testify to the crystalline character of absorption. Three intense absorption lines with maxima at 265, 345 and 450 nm were observed. These lines are somewhat shifted (by 3-5 nm) and broadened in comparison with those of the solid C_{60} [1], which we associate with the hydration of C_{60} fullerenes [2]. It was found that the increase of C_{60} fullerene concentration in water leads to the increase of absorption.

Moreover, the IR absorption spectra obtained in the wave number (900-2000) cm^{-1} range testify to the possible polymerization of C_{60} fullerenes in water solution preliminarily deposited on the Ge-substrate. Three intense absorption bands at 987, 1193 and 1443 cm^{-1} were observed. These values of absorption lines are in a good agreement with experimental data [3] for various types of C_{60} polymers.

Thus, we declare the simultaneous presence of solid C_{60} and C_{60} polymers in the C_{60}FWS prepared. The experimental results obtained were confirmed by theoretical calculations of the structure and vibrational spectra of investigated samples.

[1] W. Kratschmer, L.D. Lamb, K. Fostiropoulos and D.R. Huffman, Nature, 1990, 347, 354.
[2] L. Bulavin, I. Adamenko, Yu. Prylutskyy et al., Phys.Chem.Chem.Phys., 2000, 2, 1627.
[3] B. Sundqvist, Fullerenes under high pressure. in Fullerenes: chemistry, physics, and technology. // Edited by Karl M. Kadish and Rodney S. Ruoff, John Wiley & Sons, Inc., 1999, p.611-690.

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PERSPECTICES OF AMORPHOUS SILICON FOR He-Ne LASER LIHGT SENSITIVE PHOTODIODES

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Studies of the photoelectrical and optical properties were previously studied on hydrogenated amorphous silicon (a-Si:H) films for their possible application for construction of an efficient photodiode for He-Ne (632 nm) laser light detection.

In this paper we present the summarized results of the research in the a-Si photodiodes, prepared by plasma-enhanced chemical vapour deposition (PECVD), for He-Ne light sensing. The development of the optimal architecture of the photodiode is related to the conditions and parameter change under which, most sensitive diodes were obtained. Results showed that, once the preparation conditions for the a-Si are optimised, the considerable enhancement on the device sensitivity could be achieved by change of the diode structure, the thickness of the intrinsic layer, interface roughness of the molybdenum bottom electrode layer. The diode parameter deterioration was observed on the diodes as they undergone heavy working conditions (long-term He-Ne light illumination). The He-Ne laser illumination appeared to induce more damages than the white light.

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ON THE CURRENT – VOLTAGE CHARACTERISTICS OF SOME THIN – FILMS HETEROSTRUCTURES OF TYPE METAL/ORGANIC POLYMER/METAL

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The studied organic compounds are three new poly(ester-syloxane) urethane elastomers. Organic thin films (d = 0.12μm – 0.83 μm) were deposited from dimethylformamide solutions. The films with stable structure have been obtained if, after deposition, they are submitted to a heat treatment, consisting of several heating/cooling cycles within a determined temperature range. For heat-treated samples, the temperature dependences of the electrical conductivity and Seebeck coefficient are reversible. The polymers have semiconducting properties.

Using thin-film sandwich cells of the type Al/polymer/Al, the static current – voltage (J–V) characteristics have been studied. At lower values of the electric field ($E < 8\ 10^2$ V cm^{-1}), J–U characteristics are ohmic. At higher fields the current density increased faster than linear. For $E = 10^3 – 10^4$ V cm^{-1} the experimental results are in good agreement with the Richardson – Schottky law. For explanation of these characteristics at $E > 10^6$ V cm^{-1}, the electron transitions through and over the potential barriers at metal/polymeric film interface are taken into account.

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THE STEP BANDS' INFLUENCE ON THE FORM AND ORDERING OF SELF-ASSEMBLED Ge ISLANDS ON VICINAL Si(111) SURFACES

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The process of Ge islands formation on the Si(111) surface covered with nanostep bands has been investigated. Substrates were cut from a Sb-doped *n*-type Si(111) wafer (0.01 Ω·cm) in a rectangular form ($0.3 \times 5 \times 15$ mm^3) within a misorientation angle of 4.4°. The long side was nearly parallel to the [011] crystallographic direction along which the dc or ac electric current was applied. The step bands were formed after annealing the samples at 1230°C for 0.5-2 min by passing direct current in the step-down direction. Deposition of Ge films with 5-15 ML thickness on Si surface was done using a boron nitride Knudsen cell at the heating of substrate by applied dc or ac current. The deposition rate was 0.05 nm/s, and the substrate temperatures were 450-550°C. Atomic-force microscopy (Solver P47-SPM MDT) was used to study the surface topography of the grown SiGe structures. It has been established that primary ordering of Ge islands formation along the fronts of nanosteps on the substrate took place at the heating substrate by passing dc current also as by passing ac current. Islands ordering increase if their sizes become commensurable with the steps sizes. On initial stage of islands formation a fracture of Ge film along the step's front with formation of an extended train perpendicular to front from each island in the direction of the terrace was observed. With the following annealing the Ge film is moves to the island, fixed on the step's edge. Such a character of islands formation is caused by a structural anisotropy of a Ge diffusion. The islands ordering effect amplifies sharply, if in the process of Ge deposition a substrate is heated by passing a dc current. In this case a primary ″spreading″ of germanium along the nanosteps front was observed, i.e. the factor of a structural anisotropy of a diffusion increases. The islands form also varies: islands are stretched along the steps, assuming an ellipsoidal form. Systems of highly ordered germanium nano-sized islands with dimensions of 10–20 nm and a density of 6×10^{10} cm^{-2} were obtained. The deposition of Ge at sufficiently high temperatures of the substrate prevents from the formation of structural defects in nanoislands which can take place when the epitaxial deposition is performed at low temperatures.

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ON THE ELELECTRICAL AND OPTICAL PROPERTIES OF POLYCRYSTALLINE CDS THIN FILMS

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CdS thin films (d = 0.24 –0.99 μm) were deposited onto glass substrates by the quasi-closed volume technique under vacuum. The investigations shown that the films are polycrystalline and have a hexagonal structure. It was experimentally established that the films with stable structure can be obtained if they, after preparation, are submitted to a heat treatment , consisting of several succesive heating / cooling cycles within a given temperature range (ΔT = 300 – 500K) the temperature dependence of the electrical conductivity becomes reversible. This fact indicates the stabilization of the film structure. For heat-treated samples, the values of thermal activation energy calculated from the temperature dependence of the electrical conductivity, ranged between 2.35 and 2.50 eV.

The spectral dependences of the absorption coefficient were calculated in the range 500 nm – 1400 nm from transmission spectra. The influence of heat treatment on the shape of the absorption spectra and dispersion index of refraction is studied for samples with different thinckness.

Optical energy gap, calculated from the absorption spectra was in the range 2.30 eV – 2.40 eV.

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DESTRUCTION-POLYMERIZATION TRANSFORMATIONS IN VITREOUS As_2S_3-GeS_2, INDUCED BY γ-IRRADIATION

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Chalcogenide vitreous semiconductors (ChVS) are intensively studied in last years owing to their wide application in optoelectronics and dosimetry of high radiation doses. However, the convenience microstructural model of radiation-induced effects is developed only for simplest and binary As-based ChVS.

In the present report, it is made an attempt to develop, for the first time, the coordination defects (CD) formation model for γ-induced structural transformations in the ternary As-Ge-S ChVS system, restricted only by simple binary As_2S_3 and GeS_2 components.

The ChVS samples of $(As_2S_3)_x(GeS_2)_{1-x}$ system ($0.2 \le x \le 0.8$) were prepared by a standard melt-quenching method and irradiated with γ-quanta of ^{60}Co sources.

It was shown that fundamental optical absorption edge of all investigated ChVS shifted towards lower photon energies after γ-radiation treatment. The CD formation model based on the concept of covalent chemical bonds switching was developed for the microstructural explanation of this effect. The topological schemes of the CD formation were proposed, taking into account results obtained by IR Fourier spectroscopy method of additional reflectivity in 400-200 cm^{-1} range.

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LOW CURRENT IMAGING SPECTROSCOPY BY MeV MICROBEAM

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The development of polycrystalline diamond grown by Chemical Vapour Deposition (CVD) has progressed dramatically in the last ten years. Its unique electrical, thermal and mechanical properties make it an excellent material for use in a variety of novel sensors and electronic devices. However, the electrical properties of such diamond sensors are highly dependent on the quality of the film, particularly the average size and orientation of the diamond crystallites.

Signal currents produced by diamond sensors are presently limited by relatively short charge drift lengths within the CVD diamond, caused by the combination of shallow and deep traps and recombination centres. Generally the deep defects are also observed in natural diamond, whereas the shallower traps are characteristic of CVD materials and are possibly associated with intra-grain defects or defects at grain boundaries. The recent development of high spatial resolution ion beam imaging methods such as Ion Beam Induced Charge (IBIC) now offer powerful techniques to map the nature and distribution of such defects.

The measurements were done at the Ion Beam Imaging Spectrometer of the University of Surrey, which is a new facility that has been developed for use on the microbeam line at the new High Voltage 2 MV Tandetron Accelerator. The spectrometer performs imaging with micron sized spatial resolution, its temperature controlled stage maintains the samples in the range 100-300 K with computer controlled temperature ramping. The direct measurement of the distribution of the crystallite sizes and their relation to the sensor's electrode spacing are done by a sequence of IBIC images showing the charge transport.

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DIELECTRIC PROPERTIES OF POLY (1,4-PHENYLENE ETHER-ETHER-SULFONE)

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The polymer Poly (1,4-phenylene ether-ether-sulfone), a commercial product of Aldrich Chem. Com., is rigid at room temperature and has high softening deformation temperatures. This so-called engineering plastics has great potential for many technological applications [1]. In this respect, it is essential to investigate its dielectric properties.

Dielectric properties of Poly (1,4-phenylene ether-ether-sulfone) are obtained from dielectric spectroscopy using a HP Analyzer 4192A in the frequency range of 50 Hz to 10 MHz. The powder pellets are sandwiched between two blocking electrodes. The values of relative dielectric constant , dielectric dissipation factor and complex impedance are obtained at temperature 75 oC. The temperature dependence of the values of these parameters is investigated for three frequencies (80 KHz, 800 KHz and 8 MHz).

The temperature dependent DC conductivity is related to the DC resistance R at temperature interval 25 ºC - 95 ºC. Fitting the experimental data, the value of activation energy U [2] is obtained.

[1] Saunders. H. E. Schosh K. F., Jr. Machine Design, 161, 1992.
[2] Capaccioli S. Lucchesi M. et al, Condens. Matter, 10, p.5595, 1998.

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DRY OXIDATION OF 6H-SiC

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SiC is a large band gap semiconductor, promising for high power and high frequency devices. Since its native oxide is SiO_2, some aspects of silicon wafer processing technology, such as thermal oxide growth may be transferable to SiC with little modification. However the growth rates of thermal oxide on SiC are substantially slower than on Si, and the polar nature of SiC crystals manifests itself in different oxidation rates along the polar directions $<000\bar{1}>$ and $<0001>$ in the hexagonal polytype. The electrical quality of the SiO_2/SiC interface is significantly inferior to that of the SiO_2/Si interface.

The thermal oxide growth mechanisms along each of the polar directions must depend, amongst other things, on the nature of the SiO_2/SiC interface, since this is the main characteristic which differentiates the two faces perpendicular to the polar axis. A thorough understanding of the growth mechanisms may give us new insights into the nature of this interface.

We have determined growth kinetics for ultra-dry thermal oxidation of 6H SiC by oxidising in $^{18}O_2$ at 1100°C and 100 mb pressure, and determining oxide thickness as a function of oxidation time via $^{18}O(p,\alpha)^{15}N$. In this case, the growth is faster on the carbon-terminated $(000\bar{1})$ face. The pressure dependence has been also determined from 3 to 200 mbar. At low pressure, the oxide growth rates along the two polar directions are virtually the same.

We have also performed isotopic tracing experiments at 1100°C and 100 mbar in $^{18}O_2$ and $^{16}O_2$ gases, determining ^{18}O depth profiles via the narrow resonance at 151 keV in $^{18}O(p,\alpha)^{15}N$. In this experiment the surface exchange from the oxide growth can be dissociate on both the silicon and carbon terminated faces of SiC.

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MAGNETO-OPTICAL RECORDING AND THE PROPERTIES OF MNBI DOPED WITH RARE EARTH ELEMENTS THIN FILMS

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Magneto-optical (MO) Recording combines the merits of magnetic and optical techniques, i.e., in principle, the unlimited reversibility of magnetic media and the high bit density combined with contactless write, erase and read operations of optical disk systems. Now, MO recording has established a presence in the storage hierarchy. As a disk medium it has been commercialized at the end of last century. The most media for the erasable MO recording are based on amorphous rare-earth (RE) transition-metal (TM) alloy. However, it still needs to be improved due to the small figure of MO merit and easy oxidation.
After briefly introducing the principle of MO recording, we describe what we developed MnBi doped with RE elements thin films.

MnBIRE thin films were prepared by the vacuum evaporation method at about 2×10^{-6} Torr. These RE elements include Ce, Pr, Nd, Sm, Tb, Dy and Ho. We found that these films exist positive anisotropy and the grain size is about 50nm. The Kerr rotation θ_k and reflectivity R as a function of wavelength for all the samples were measured at room temperature. It was found that MnBi doped with Ce, Pr, Nd and Sm (as RE concentration $x\approx0.25$) thin films have large enhanced MO effect, And their θ_k can reach over 2°. But there is no such enhancement by doped with Tb, Dy and Ho into MnBi films. The value of θ_k decreases with the increase of the doped amount of those RE elements, The magnetic measurement shows that the Curie temperature only has small difference among MnBiRE samples as $x<0,3$ and its value is very close to that of the pure MnBi film (i.e. about 360Cº). This can be explained by using the Heisenberg exchange model.

The thermo-magnetic writing was carried out. The readout and written characteristics of the samples are discussed.

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INVESTIGATION OF BRITTLENESS ANNEALED METALLIC GLASS BY BOTH MICROINDENTATION AND *U* – METHOD

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Fabrication and application of metallic glasses (MG) is of particular scientific and practical interest. One of the negative moments in application of MG exhibits tendency to brittleness accompanying thermal treatment Thus reception of an information about this question is of great significance.

We studied an 82K3XCP (in Russian) metallic glass of the composition (wt %) 83.7Co+3.7Fe+3.2Cr+9.4Si in the form of a ribbon 30 μm thick. Prior to experiments, samples (3×10 mm) were annealed in a furnace, in the temperature range of T_{an}=538-900K and held at a specified temperature for 10 minutes. The character of deformation and fracture of the MG were investigated by *U* – method and by method of microindentation of the MG deposited on a substrate. We tested 15 samples at each temperature for statistics. In the traditional *U* – method we estimated the deformation of bend at which take place brittle fracture of the MG. The microindentation of the MG deposited on substrate was carried out on a PMT-3 microhardness gauge.

The dependence of the deformation of bend on the annealed temperature is found by *U*-method. At the T_{an}<628K the fracture is not observed, if we bring bend to contact of ends of sample. It is happened thanks to the plastic deformation, which display in rise of slip bands. The visible loss plasticity starts at a T_{an}≈628K accompanying formation main crack and leading to fracture of sample. The further reduction occurs with beginning crystallization MG. The loss plasticity leads to growth brittleness correspondingly. At a T_{an}≈823K conform to maximum brittleness connect with transition in a submicrocrystallic state. This temperature coincides with data of differential scanning calorimetry at which runs crystallization MG.

The critical temperature of annealing at which emerges of cracking formation during microindentation (T_{cr}), macropictures of destruction and deformation of the MG after indentation depends for material of substrate and his properties. At the same time, the experimentally established critical temperatures, which correspond to ductile - brittle transition, are near by for all substrates. The endurance to cracking is lowered exponentially after exceeding T_{cr} and reaches the minimal value near temperature of crystallisation. Thus, the brittleness is raised exponentially after exceeding T_{cr} and reaches the maximal value near temperature of crystallisation correspondingly. These results tally with analogous results of *U* – method. As a result, the data of *U* - method and data of microindentation may be united and may be used for analysis of structure and mechanical properties of metallic glass.

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TUNABILITY OF EXCHANGE COUPLING WITH HYDROGEN: PLAYGROUND FOR STUDY OF LOW-DIMENSIONAL MAGNETISM

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The discovery of oscillations of interlayer exchange coupling (IEC) with thickness of layers in metallic magnetic superlattices opens a new field in low dimensional magnetism. Reversible accumulation of the hydrogen in some metals (Nb, V) offers a way for manipulation of IEC in magnetic superlattices via continuos variation of the spacer's thickness [1]. In Fe/V superlattices loading with hydrogen leads to an expansion of the vanadium spacer layer by as much as 10% at moderate H pressures without any memory effect.

Electronic and magnetic structures of Fe/V superlattices with and without hydrogen in vanadium spacer layers were investigated using a relativistic full-potential linear muffin-tin orbital method [2]. Hydrogen loading leads to the decrease of both the interface magnetic moments on V atoms and of the density of states (DOS) at the Fermi level. Low DOS can be one of the reasons for the increase of the superlattice resistance under hydrogenation and of the disappearance of the AF IEC for large hydrogen concentration [1]. Due to the AF coupling between Fe and V, the decrease of induced V moments at the interface has to increase the total magnetic moments of the Fe/V superlattice with hydrogen uptake. This prediction was confirmed by experiments with highly sensitive Faraday balance and in-situ loading with hydrogen [3]. But the variation of the total moment was found to be more then ten times larger then in *ab initio* calculations. Moreover, the value of the magnetic moment per Fe atom was shown to be very low (0.35 μ_B for Fe_3V_{11}). This disagreement was explained via calculations of the magnetic structure taking into account interface roughness and interdiffusion [4]. Intermixing was introduced to the model by a recently developed random algorithm. Thus, it was demonstrated that interface alloying has to be taken into account for adequate description of these systems.

Tuning of H concentration, which can be achieved by a slight variation of the external hydrogen pressure, leads to a continuous transition from quasi-two-dimensional to three-dimensional magnetic structure. In particular, it is shown experimentally that the Curie temperature of the Fe films in Fe/V superlattices decreases with IEC strength.

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[1] B. Hjörvarsson et al. Phys. Rev. Lett., 79, 901 (1997)
[2] S. Ostanin et al. Phys. Rev. B 61, 4870 (2000)
[3] D. Labergerie et al., J. Magn. Magn. Mater. 225, 373 (2001)
[4] V. Uzdin et al., J. Magn. Magn. Mater. 240, 481 (2002)

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SYSTEMATIC IR STUDY OF HYDROGENATED AMORPHOUS CARBON FILM PREPARED IN A BROAD PRESSURE AND SELF-BIAS VOLTAGE RANGE

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A detailed infrared (IR) spectroscopic study was carried out on an ensemble of hydrogenated amorphous carbon (a-C :H) films, which were prepared from methane or benzene in a broad range of gas pressure and deposition voltage. All expected C-H vibration modes were decomposed and assigned, which were expected on theoretical basis, but have not been recorded experimentally in a-C:H samples yet.

At low self-bias voltage the polymeric film will be formed, by soft landing of the molecule-radicals. Under such conditions sufficient aromatic component remains, if the precursor material was aromatic. Increasing the self-bias voltage the energy of the impinging radicals increases also, the second characteristic deposition condition region is reached; the sub-plantation process crashes more and more strongly the aromatic radicals. The increasing internal stress broadens the gaussian components of the various vibration frequencies. The aromatic components disappear from the spectrum. By further increase of the self-bias voltage the third characteristic regime arrives. The high voltage supplies enough energy to the implanted fragments to nucleate the graphite sheets in the depth of the a-C:H film, local graphitization starts and the aromaticity begins to increase again. The half-width of the component lines decreases.

The high information content of the IR spectra will be demonstrated in the paper with the detailed analysis of the measured spectra. It will also be shown, that IR spectra is a good source for information concerning building elements of the amorphous carbon structure. Some samples will be discussed with specific C-H configurations dominate the structure.

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MAGNETIC MEASUREMENT OF Cr_3Si DOPED Fe AND Co

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Polycrystalline samples of $Cr_{3-x}TM_xSi$ (where x = 0.02, 0.1, 0.2, 0.3; TM = Fe, Co) were prepared from pure elements in the arc furnace. The magnetization of these samples was measured by VSM method as a function of magnetic field (-12 kOe to 12 kOe) and temperature (10 K to 300 K). With increasing iron concentration the $Cr_{3-x}Fe_xSi$ alloys change from the paramagnetic ($x \leq 0.2$) to the ferromagnetic (x = 0.3) ones. In the case of Co impurities the ferromagnetic properties were observed in the most diluted samples (x=0.02).

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DIMENSIONALITY AND CHARGE-ORDERING IN QUASI-ONE-DIMENSIONAL ORGANIC CHARGE-TRANSFER SOLIDS

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The pressure/temperature phase diagram of quasi-one-dimensional TMTTF-salts has been studied by NMR spectroscopy and relaxation in $B = 9$ T magnetic field. In $(TMTTF)_2AsF_6$ the pressure dependence of the charge-ordering (CO) transition as well as of the low-temperature spin-Peierls (SP) transition was investigated. With the application of about $P = 0.15$ GPa pressure, T_{SP} increases substantially, while T_{CO} is rapidly suppressed. Within the intermediate, CO phase, the charge disproportionation ratio is found to be at least 3:1 from ^{13}C NMR T_1^{-1} measurements on spin-labeled samples. The appearance of the phase diagram demonstrates that the two orders are competing. The results are interpreted in the framework of the 1D extended Peierls-Hubbard model. Comparison with $(TMTTF)_2SbF_6$ reveals the effect of the dimerization on the dimensionality and its importance for interpreting the phase diagram of these materials.

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FIRST OBSERVATION OF THE FOURTH NEUTRAL POLARIZATION POINT IN THE ATMOSPHERE

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Our poster reports on a historic advance in atmospheric optics, namely, on the first observation of the fourth neutral polarization point in the atmosphere, which is the last principal neutral point that has not been observed previously during air- or space-borne polarimetric experiments. In the clear sunlit sky there exist only three loci, the Arago, Babinet and Brewster neutral points, where the skylight is unpolarized. These peculiar celestial points, bearing the names of their discoverers, have been the subject of many ground-based investigations, because their positions are sensitive indicators of the amount and type of atmospheric turbidity. Under normal atmospheric conditions, from the ground only two of them (either the Arago and Babinet points, or the Babinet and Brewster points) are visible at a given time, as the Arago point sets below the horizon at the same time the Brewster point appears above it, and vice versa. At the last time, David Brewster has reported on the ground-borne observation and the existence of a new neutral point of skylight polarization in 1842. According to theoretical considerations and computer simulations, approximately opposite to the Babinet point there should exist an additional neutral point, which can be observed, however, with difficulty only at higher altitudes in the air or space. 160 years after Brewster's discovery we observed as first this anonymous neutral point.

Using 180^o field of view imaging polarimetry, a technique which has already been proven to be an effective tool for quantitative studies of neutral points, we measured the spectral and polarization characteristics of the fourth neutral point from a hot air balloon at 450, 550, 650 nm from different altitudes between 900 and 3500 m during and after sunrise at about 22^o-40^o below the anti-solar point along the anti-solar meridian, depending on the wavelength and solar elevation. We showed that the fourth neutral point has similar features as the well-known Arago, Babinet and Brewster points. (1) It is located along the anti-solar meridian at the edge of the areas of positive and negative polarization of earthlight; (2) at sunrise it is about at the same angular distance below the anti-solar point as the Brewster point below the sun; (3) its nadir angle decreases as the wavelength decreases; (4) its position and the polarization characteristics of earthlight around it are influenced by ground reflection, the effect of which decreases as the altitude increases and/or the wavelength decreases; (5) its nadir angle is decreased by multiple scattering on atmospheric aerosols increasing the areas of negative polarization of earthlight.

In spite of several earlier attempts, the fourth neutral point was not observed during previous air- or space-borne polarimetric experiments and/or it escaped the attention of researchers, because (i) some of these measurements were performed at longer (red or infrared) wavelengths in order to minimize the contribution of molecular scattering at shorter

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(ultraviolet and blue) wavelengths; (ii) the majority of the previous polarimetric techniques was not adequate to measure neutral points; (iii) the routinely used point-source scanning polarimeters were not pointed towards the fourth neutral point; (iv) unpolarized points did not show up explicitly in the polarization maps due to an inadequate, disadvantageous colour coding and displaying of the data measured by imaging polarimetry.

In atmospheric optics more attention has been paid to the measurement of the positions of the Arago, Babinet and Brewster neutral points than to any other feature of skylight polarization. These studies are now complemented by our air-borne imaging polarimetric measurements and explicit visualization of the characteristics of the fourth neutral point of atmospheric polarization.

Acknowledgements: This work was supported by a Humboldt fellowship from the German Alexander von Humboldt Foundation and by an István Széchenyi scholarship from the Hungarian Ministry of Education to G. H., and by the grant 31-43317.95 from the Swiss National Science Foundation to R. W. We are grateful to I. Cseraljai, E. Svájer, O. Bogdányi (Hot Air Ballooning Dept., Hungarian Airlines Aero Club MALÉV, Budapest) for their assistance during our balloon flights. We thank S. Hopp and E. Berecz for the production of the polarimeter´s holder.

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UNIVERSAL PHYSICS AND ENVIRONMENTAL PROTECTION

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The environmental protection as a new branch of natural siences occupies to day increasing public and scientific interest and receives increased budgeting. Despite this fact most of its general rules are far from derivation from "first principles" as physicist would like. In fact the rational and exact phylosofy of physics is frequently absent from the foundations of environmental protection. As one of the most striking examples we can quote the universal "sustainable developpement" principle based to day on the very subjective judjement on that what is sustainable. This problem and other possible fields where physics should be much more engaged in environmental protection will be discussed in the paper.

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COMMENT ON RADON CONCENTRATION IN SIBIU DISTRICT (ROMANIA) UNDERGROUND WATER

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A survey of Radon (^{222}Rn) concentration in Sibiu district underground water was conducted. A LUK 3A device was used to measure the Radon concentration in air. The Radon gas was extracted from water using the LUK VR device that works with LUK 3A.

All samples were taken on November 2000, using the same procedure, in 0.5 l recipients that were filled and sealed. Samples from eighteen cities and villages were taken. Special care was taken for the samples to be carefully brought to room temperature and not to be agitated or stirred before measuring the Radon concentration.

In measuring the Radon concentration some corrections were applied. These are the solubility coefficient variation with temperature, the radon concentration increase in air with time passing and the background correction.

Results reveal that the underground water radon concentration is bigger in wells located in mountain area, has an average value in wells from hill region and is considerable lower in wells located in plain area.

Another thing to be noted is that the samples taken from the city water pipe system contain lower Radon concentration values than samples taken from home wells. This can be easily explained as ^{222}Rn decays with a halftime of 3.8235 days and in cities Sibiu and Agnita mentioned here drinking water is taken from a mountain river, 25 km and 40 km away from town. Water is collected in a reservoir and where it spend some time before being distributed to consumers.

The minimum Radon concentration value was found in the drinking water of Sibiu city, 1.6 Bq/l and in Sadu village, 1.965. The sample in Sadu is taken from the river that feeds the Sibiu city with drinking water and the values are small because the sample is taken from a river not from a well.

The highest measured value is 28.1 Bq/l in Rasinari, a village located at the bottom of the mountains and in 26.4 Bq/l, in Sibiel, a village 30 km away from the first one.

These results reveal that the Radon concentration values measured in Sibiu county are comparable with the measured values reported in literature and well below the maximum acceptable values.

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DETERMINATION OF URANIUM AND THORIUM CONTENT IN MINERALS FROM MARIOVO, R. MACEDONIA, BY KO-INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS

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The levels of natural radioactivity from radionuclides K-40, U-238 and Th-232 and their daughter-products may be a source of indoor radioactive pollution. The behaviour of radio-nuclides in the environment is an important part of the general study of radionuclides migration and may even be taken as analogous to the possible behaviour of radionuclides in case of accident at a radioactive waste repository or at nuclear fuel plant. Some natural radionuclides of concern in this study are Uranium, Thorium and Radium, since the concentration of these elements at each site can lead to an understanding of the mobilization mechanisms.

The Ko-standardization method of NAA was applied for determination of radioactive elements in some minerals from the Alinci and Kokre sites (old mines), R. Macedonia.

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USE OF A POLARIZATION LIDAR FOR ECOLOGICAL PURPOSES

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The observations of the processes, taking place in the entire planetary boundary layer of the atmosphere in the case of table stratification and during the development of a convection boundary layer correspond thoroughly to the capabilities of the comparatively simple aerosol lidars.

The determination of the mixing layer height and its changes in time after the sunrise and respectively, after the sunset. It influences the air quality over populated areas, since is of considerable importance for such investigations.

Recently methods are used allowing automated determination of the mixing layer height, e.g., through the first and second derivative of the lidar signal, the maximum of the standard deviation of the signal, etc.

In the present study is made an attempt to enhance the possibilities for determination of the mixing layer height by the use of a ground-based polarizati lidar in case of stable and convective boundary layer.

The utilization of the polarization characteristics of the lidar signal increases the lidar capabilities in this case the polarization characteristics of the signal contribute to a more detailed analysis of the optical characteristics of the aerosol layers.Besides the share of the aerosol particles could be defined terminated within the different atmospheric layers on the base of the depolarization coefficient profile along the sounding. path juxtaposing the temporal variation of the atmospheric humidity profile with the optical characteristics of the aerosol structure their interaction could studied.

Polarization investigations are ready made applicable in hard and hazard ecological situations, in presence of fogs or smog formation over populated areas.

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ATMOSPHERIC HEAVY METALS DEPOSITION IN TRANSILVANIAN PLATEAU STUDIED BY MOSS AS BIOMONITORS USING NUCLEAR TECHNIQUE AND GIS TECHNOLOGY

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This paper presents data for 39 elements of 69 moss samples (Hypnum cupressiforme) collected in the Transilvanian Plateau of Romania. This results have obtained in the framework of the project "Atmospheric Deposition of Heavy Metals in Rural and Urban Areas of Romania Studied by the Moss Biomonitoring Technique Employing Nuclear and Related Analytical Techniques and GIS Technology" carried out under the auspices of the International Atomic Energy Agency, Vienna.

The samples collected have been analyzed by ENAA with the exception of Cu, Cd, and Pb which were determined by AAS. IAEA certified materials were used to ensure the quality of the measurements. The regional concentration variations of selected elements are presented in the form of maps constructed by GIS technology.

Extremely high values are observed for elements such as Cu, Zn, As and Sb in parts of this territory affected by local metal industries. The levels are among the highest observed in the world, and could be partly responsible for the unfortunate health situation in some of these areas.

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FUTURE PROSPECTS OF NUCLEAR ENERGY

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The purpose of this contribution is to discuss the present status of nuclear and the prospects for its extended use in the next hundred years. Public opposition against nuclear power is mostly due to fear from accidents, proliferation and nuclear waste. These factors can either be eliminated or alleviated by scientific and technological developments. Nuclear waste may be transmuted in so-called accelerator driven systems (ADS). Such an ADS can also be used for energy production, and can utilise thorium, an abundant element, as fuel. In the US, continued use of nuclear power is planned with the development of the so-called "Generation IV" reactor types. The motivation lies in
- reduction of greenhouse gases
- transition to hydrogen as energy carrier ("hydricity")
- first generation plants get aged - need to be replaced.

There are many new exciting reactor concepts under development, including the ADS, the pebble bed modular reactor, the "candle" (burnup-wave type) reactor proposed by E. Teller a few years ago, the fluidized bed reactor etc., which fulfil the above goals.

The lecture will discuss the physics and properties of such new nuclear energy systems.

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IRON STEEL CONTAINER FABRICATION, CLOSURE AND CORROSION REQUIREMENTS UNDER WASTE DISPOSAL CONDITIONS

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An important engineered component is a corrosion-resistant container intended to provide the isolation of the fuel waste from contact with groundwater for at least 500years, the period during which most radionuclides decay to negligible levels. Most of container designs that have been conceived are based on a relatively thin shell, supported internally against the service stresses by either a packed particulate, a cast- metal matrix or by internal structures. The container metals studied in our paper were some iron steel such as: carbon steel, stainless steel and Ni- riched alloys. The main directions followed by us were the prediction of the life time of container materials in a variety of vault environment; the establishment of the limiting range of conditions (e.g.T,γ dose, salinity, etc.) beyond which a specific container material cannot be used; the establishment- on the basis of corrosion rate data - of mechanistic models necessary to make the best predictions. In view to accomplish the above-mentioned objectives, our targets were: the obtaining during fabrication of a controlled, uniform microstructures of the base metal, the weld and the heated affected zones (HAZ) of the welds; controlled microchemistry; low residual stresses; small welding and heat-affected zones; reliable methods of flaw detection by both surface and volumetric activities. The container metals proposed and respectively tested in certain laboratory conditions simulating the HLW (High Level Waste) disposal situations were: the carbon steel SA 106 gr.B; the stainless steel 304L and 316 and the Incoloy - 800. For containers closure we recommended the electron - beam welding. On the basis of the corrosion tests executed in several aqueous environments at the room temperature and respectively at other temperatures until 100^0C, we established a ranking of these materials concerning to their corrosion resistance in the respective testing environments. On the basis of a literature review and of all experimental data, we tried select the most proper materials for the HLW containers.

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A CRITICAL EXAMINATION OF FUNDAMENTALS IN SCIENCE

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Each theory is an approximate reflection of reality and its application is of limited use for various reasons. At present a considerable number of scientists speculate that the theory of relativity (the special theory as well as the general one) is wrong, when applied in case of very small distances (significantly smaller than the presumed size of "elementary" particles). There are obvious reasons to assume, that the theory of relativity can be inapplicable, when applied to extremely large areas of space of order of presumed size of universe (up to the areas, where the "red shift" becomes quite considerable). One should be prepared for its critical revaluation and its eventual replacement for a more exact theory. It can be radically different from the theory of relativity. That itself differs from the Newtonian mechanics.

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ONE FORCE: CHARGE SHIFTS AND INTERACTIVE PARTICLE POSTURING CAUSES GRAVITY, WEAK FORCE AND STRONG FORCE. GRAVITONS AND GLUONS NOT REQUIRED

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A single hydrogen atom resting in a new and otherwise empty universe is an electrically neutral atom. Its neutrality comes from the facts that the positive charge of the proton counteracts the negative charge of the electron and more importantly that the center of effort of the electrical charge of the proton coincides with the center of effort, or center of orbit of the electron. As we introduce a second hydrogen atom into this new universe the above mentioned neutrality is forever gone. This is because the negatively charged electron of the second hydrogen atom is attracted to the positively charged proton of the first atom while repelled by its electron, and vice versa. The result is a charge shift in each atom producing an offset between the center of effort of the positively charged proton and the center of effort, or center of orbit of the negatively charged electron. Each of the atoms is now a bipolar device with its associated electromagnetic field. *1. The result is one where distances between attracting centers of effort are infinitesimally shorter than the distances between repelling centers of effort. Mathematically, using nothing but the inverse distance square relationship between the four charges, there is now a tiny net attraction between the two atoms. *2. Extensive computer simulations show the interactions and the ultimate attraction between any number of atoms, clouds or clumps of atoms and bodies in space. Interactive Charge Shifts, or Interactive Particle Posturing, causes General Gravity. In the case of general gravity in space, the main facilitator is the shift of the center of effort, or center of orbit of the electrons. In an electron-less neutron star the electrically charged quarks posture themselves within the neutron nuclei in response to the influence of adjacent neutrons. Positively charged up-quarks are attracted to negatively charged down-quarks while repelled by other up-quarks and vice versa. The subsequent pattern is one where attracting forces outweigh repelling forces producing General Gravity. In a neutron star the distances between the neutrons are short, producing large forces of General Gravity between the neutrons.

Strong Force between positively charged protons in an atom nucleus is caused by Charge Shifts and Interactive Particle Posturing of the quarks in the proton nuclei. This quark nesting is conditional and geometry dependent. It appears like a strong force with a short reach. It is actually a 3 dimensional resultant of force vectors acting between up- and down-quarks to form an Electric Nest, inside of which a proton is captured by a strong, composite, implosive force and outside of which it becomes strongly repelled.

See abstract titled: “Strong Force, Interactive Particle Posturing and Electric Nesting. “
*1. See abstract titled: “Charge Shifts, the engine in electromagnetic fields. “
*2. The posturing described above is unconditional but bi-stable. Either electron can become the “inside” electron, by “chance” or by exposing the atom-pair to an external electrical influence. This offers a compact, bi-stable mechanism for an atom-pair memory cell, or processor switch, requiring no stand-by power.

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ACCELERATION OF MACROPARTICLES TO HYPERVELOCITY

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We have previously considered the achievement of hypervelocities with railgun and plasma ring accelerators[1,2] using the acceleration of heavy elements. In order to increase the velocity we are now considering the acceleration of light elements, namely lithium, considering a railgun plasma ring accelerator. A circular, initial radius $R_0 = 0.2$ m lithium wire, diameter 0.141 mm, mass $m = 1.085 \times 10^{-5}$ kg, is connected and can slide along two rails connected to a 6 MV, 6 MJ Marx generator. A constant $B = 10$ teslas magnetic field , perpendicular to the circular loop, is directed downward. The initial flux is $F_0 = 1.256$ weber. A counterclockwise current $I = 4.32$ MA results in an implosion of the wire; its radius decreases to R and the flux becomes $F = \pi R^2 B$ corresponding to a velocity $V = -dR/dt$ checking $V^2 = 2(F_0-F)I/m$. The maximum velocity at the center is $V_m = 1000$ km/s and this is more than enough to induce fusion reactions in a D-T target[3]. Under constant current conditions the radius and the velocity of the lithium ring grow according the equations $R = R_0\cos(pt)$, $V = V_m\sin(pt)$ where $p = (2\pi BI/m)^{1/2} = 5\times10^6$ rd/s, $v_m = R_0 p$ and t is the time. The center is reached at $T_m = \pi/2p = 0.314$ microsecond. It is short enough to prevent the growing of instabilities[4].

The motion impedance of the collapsing ring is $Z = Z_m \sin(2pt)$. $Z_m = mp^3R_0^2/2I_2$. Its average value is $Z_a = 2Z_m/\pi = 0.926$ ohm corresponding the final kinetic energy of the macroparticles $W = Z_a I^2 T_m = 5.428$ MJ. Obviously the magnetic field B partially compensates the electromagnetic repulsion between the rails and besides contributes to magnetic insulation.

A. Pozwolsky, Acta Physica Acad, Scient. Hung., 44, 385 (1978)
A. Pozwolsky, Indian J. Pure Appl. Phys., 17 760 (1979)
F. Winterberg, Z. Naturforsch., 19a 231 (1964)
W. Lochte-Holtgreven, Atomenergie (Germ.) 28, 150 (1976)

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QUANTIZATION OF CONSTRAINED SYSTEMS USING THE WKB APPROXIMATION

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A general theory for solving the Hamilton-Jacobin partial differential equations for constrained Hamiltonian systems is proposed. The Hamilton-Jacobi function is obtained in the same manner as for regular systems. This is used to determine the solutions of the equations of motion. The quantization of constrained systems is then applied using the WKB approximation. The constraints become conditions on the wave functions to be satisfied in the semi-classical limit. This is illustrated through four concocted examples that cover all types of constraints

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ABOUT THE DUALISM OF THE LIGHT

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In the course, and especially in the last century, substantial successes were obtained with the investigation of the light due to the outstanding achievements by scientists like Newton, Einstein, Wien, Plank, Broglie and many other. In the meantime the theories were developed, which had considered either the particle or wave characteristics of the light. To refer to, that the experiments, which investigated the particle movements, exclusively ascertained the particle nature of the light, and the experiments, with those the wave characteristics were examined, referred to the typical wave charakter of the light. It became clear, that the light has strangely the dual characteristics at the same time. Thus phenomenon – dualism of the light - was determined.

From today`s view one can say that the dualistic and puzzling behavior of the light was not clarified in detail yet. In spite of all successes of quantum mechanics, there are still today some serious understanding obstacles, which have to be eliminated in the future.

One of those is the mass of the light particle. In contrast to classical physics it was postulated that a photon doesn`t have certain mass. The attempts to bridge the conseptions of the classical theory with quantum mechanics, failed up to now. A question arises whether the photons are really not material, and a kind of substance, whose nature we will never be able to understand? How does the real nature of the light look like - is it a wave or a particle medium? Can it really be possible, that the light is not material, although it transports much energy and has a certain pressure and that it owns the wave and the particle characteristics at the same time, which are, as we could see, in a physically harmoniuos world. These and other questions of the dualistic phenomenon were treated in the stated work.

Due to the new postulated movement principle of a light particle the dualistic behavior of light is explained successfully. The executed research shows, that the light radiation can be regarded as particle stream as well as a material wave, which had predicted Broglie. For the first time the mass of the light particle- photon was defined.

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SOLVING INVERSE PROBLEMS OF 2-D SYSTEMS IN PHYSICS AND ENGINEERING MATHEMATICS: A NEW EFFECTIVE METHOD

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The inverse problems are the important problems in different parts of physics, e.g. in nuclear physics, geophysics, astrophysics. Within modelling of physical systems, the problem of identification of field sources is one of some investigated inverse problems by known scientific teams. The solutions of this problem are of importance in the practice. Very often, in nature as well as in technological and industry processes, it is necessary to identify internal sources of the systems. For the reason of different limits which consist more often in troubles with making accurate measurements, the correct determination of position and intensity of sources generated field can not be done. For correct identification the special mathematical procedure must be used to support the knowledge based on possible measure data obtained in such conditions. New approaches to solve inverse problems of 2-D systems are developing by author of this paper. During investigations relating the preparation of doctor thesis, author of this paper has elaborated an effective numerical method named the combinatorial method. This method consists in the use of new computational tools constructed during previous investigations in a field of combinatorics and the Fibonacci trigonometry. In this paper the special problem of identification of internal field sources is solved for the 2-D systems in the instance that the values of potential function are known only on the border of investigated region. In this instance the sources identification problem has been investigated for the 2-D system described by the Poisson equation with specified boundary conditions. The adaptation of elaborated procedures to solve modelling problems in mathematical physics and engineering are presented and future field of investigations is indicated as well as possible fields of application in technology and industry. In the field of nuclear physics the combinatorial method can be used to solve inverse problems investigated in plasma physics, thermonuclear research and nuclear techniques applied to produce materials. It is shown that the results of presented research can be applied to build integrated computer systems for identification of thin layers properties in particular the heterogeneous spots in their structure.

Rydygier E., Field Sources Identification Using a Combinatorial Method, Doctor Thesis, Warsaw University of Technology, Warsaw 1998.
Rydygier E., Trzaska Z., Application of special smoothing procedure to numerical solutions of inverse problems for real 2-D systems, *Shape Optimization and Optimal Design,* in *Lecture Notes in Pure and Applied Mathematics Series,* N.Y., 2001, pp. 381-396.

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ENERGY LEVELS OF A RELATIVISTIC PARTICLE IN A HOMOGENEOUS ELECTRIC FIELD ORTHOGONAL TO A PIECEWISE HOMOGENEOUS MAGNETIC FIELD

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An investigation is made of energy spectrum of a relativistic charged particle moving in a homogeneous electric field orthogonal to a piecewise homogeneous magnetic field with a barrier at the boundary surface.

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THE ELECTROMAGNETIC ENVELOPE SOLITON PROPAGATING IN A DIELECTRIC

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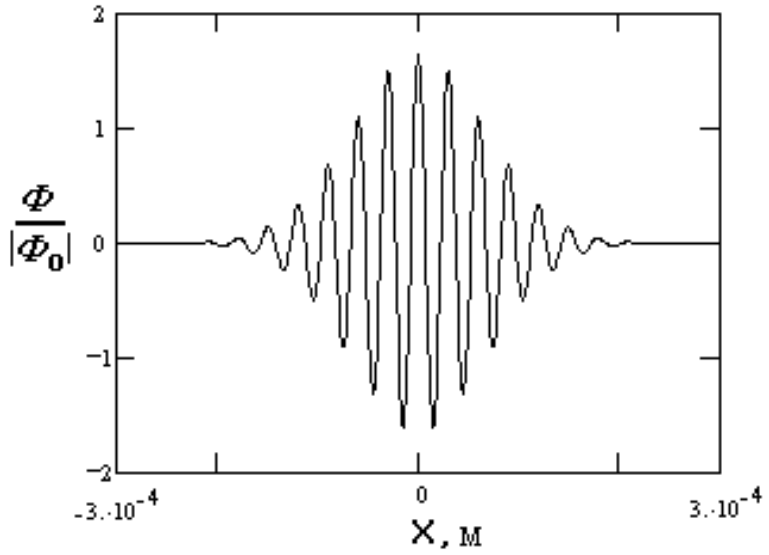
The interaction of electromagnetic radiation with a dielectric medium is described in terms of the Schrödinger equation with a logarithmic nonlinearity and a single-soliton solution to this equation is found.

$$i\beta\frac{\partial\Phi}{\partial t}+\frac{V_n}{k}\frac{\partial^2\Phi}{\partial X^2}=-\omega\left(\ln\left|\frac{\Phi}{\Phi_0}\right|\right)\Phi \quad (1)$$

It is shown that an envelope of the electromagnetic wave momentum varies according to the Gauss law.

$$\Phi=|\Phi_0|\exp\left(\frac{r^2}{k^2}-2\frac{\delta r}{\omega k}+\frac{1}{2}\right)\exp\left[-\frac{(kX-\omega t)^2}{4}\right]\exp\left[i(rX-\delta t)\right] \quad (2)$$

The wave momentum is calculated for certain values of the dielectric medium and the incident wave parameters.



The estimated number density of atoms indicates that we may ignore the backscattering of electromagnetic waves (this is possible for $n < 10^{24}$ m $^{-3}$). Therefore, Eq. (1) may describe a soliton appearing in the case of a self-induced transparency.

Unfortunately, a two-soliton solution to Eq. (1) is unknown. However, our recent numerical analysis of the interaction of solitary waves described by Eq. (1) showed that the waves behave as solitons.

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BUCKYBALLS OF QUANTUM CHROMO DYNAMICS AND GLUON JUNCTION NETWORKS ON THE FEMTOMETER SCALE

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We explore the possibility that novel geometrical structures analogous to carbon Fullerenes may exist in Nature on the femtometer scale. The theory of strong interactions, Quantum Chromo Dynamics (QCD) predicts the existence of special topological gluon field configurations called baryon junctions and anti-junctions. We show that femtometer scale structures, networks or closed (gluon field) cages can be constructed in the theory of QCD as tiny cousins of familiar nano-scale structures such as carbonic Fullerenes C_{60} or C_{70}. The most symmetric polyhedra of QCD Fullerenes are characterized by the "magic numbers" of 8, 24, 48 and 120, and zero net baryon number. Special configurations may be constructed that are odd under charge and parity conjugation (CP) although the QCD Lagrangian is CP even. We provide a semi-classical estimate for the expected mass range of the QCD Buckyballs and discuss the possible conditions under which such novel topological excitations of the QCD vacuum may be produced in experiments of high energy physics.

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PRELIMINARY RESULTS OF COSMIC RAYS MEASUREMENTS IN NOVI SAD

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High energy cosmic rays produce direct signals in detectors used for low energy γ-spectroscopy. The response of NaI(Tl) christal (9"x9" annular with 3" hole) was investigated in the region of 5 MeV – 10 GeV. The results of stability and linearity tests are presented. The origin of the puses above the μ-meson distribution is discussed.

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NON-ACCELERATOR NUCLEAR PHYSICS

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Typical case-studies of experiments are presented in which the nuclear environement is used to study particles and their interactions as well as their symmetries. These case-studies illustrate the complementarity of Nuclear and Particle Physics.

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A COMPACT DETECTION SYSTEM BASED ON THE USE OF ΔE-E MONOLITHIC TELESCOPES

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The realization of compact detection systems with low identification threshold is one of the technological needs of heavy ion nuclear physics at low and intermediate energy. If charged particle identification thresholds lower than 1 MeV/nucleon are requested, the conventional ΔE-E technique is difficult to apply and may require the use of expensive and fragile detectors. To overcome these difficulties, in the last years we started to work on the development of some prototypes of monolithic telescopes, where the ΔE and E stages are integrated in a single silicon chip. Such detectors, obtained using ion implantation techniques, consist of a very thin ΔE stage (about 1.5 μm thick) implanted on a residual energy stage having a thickness of 400 μm. Typical identification thresholds of the order of 300-400 keV/nucleon, for nuclides in the region of Nitrogen, have been observed for all the realized prototypes.

After the realization and test of detectors having different geometry, and the necessary development work, we recently built a modular detection system (MONTE: MONolithic TElescope array). The single detection module consists of a ceramic package containing 2 independent silicon strips each having dimension 15x4 mm^2. Each strip has a ΔE stage subdivided into 5 independent segments (3x4 mm^2 each) having a common ER stage. Signals from the detectors are fed into compact preamplifier boards working under vacuum. Due to its modular structure the geometry of the system can be adapted to different experimental needs. In the first experiment we performed, 12 modules were mounted around the target inside half a sphere (having a radius of about 5 cm) which was surrounded by BaF2 crystals. In the second experiment detectors were placed in plane covering an angular range 3° ÷ 45°.

The characteristics of the detection system and the first results obtained using stable and radioactive beams will be presented.

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P2 – 100

APPLICATION OF THEORETICAL MODELING OF PLUTONIUM ISOTOPIC RATIOS FOR DETERMINATION OF POLLUTION SOURCE

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The radiotoxity, long-duration half-time and non rapid clean-out processes in biological systems is the main reason of interest of plutonium analysis in various environmental samples [1]. Isotopic analysis of plutonium can give a lot of information about source of pollution [2]. The ground is a dependency of the isotopic composition on type of nuclear reactor, where plutonium is produced, or on type of a nuclear weapon, if plutonium is emitted during a nuclear test. That is important performing monitoring in environments of nuclear power plants, facilities for storing of nuclear and radioactive materials or spent nuclear fuel. The experimental methods of alpha and mass spectrometry are the most popular methods for plutonium isotopic analysis. However mass spectrometry is expensive and complicated method, the most available semiconductor alpha spectrometric method is not able to separate all plutonium isotopes. The liquid scintillation spectrometers can be used to obtain the total alpha to total beta activity ratio. The combination of experimental results and theoretical calculations can give good conclusions on identification of the source of radioactive pollution. The programs ORIGEN-S, ORIGEN-ARP, SAS2H from package SCALE 4.4 [3] were used to model plutonium isotopic composition in a spent fuel for RBMK 1000, RBMK 1500 and PWR reactors. The parameters were chosen the most typical – for RBMK – enrichment of nuclear fuel 2.0%, 2.4%, 2,6% of ^{235}U and average power 0.033MW/[1 kg U] and for PWR – enrichment 3.2% and average power 0.033MW/[1 kg U]. The calculations were made for various burn-up of nuclear fuel up to 40 MWday/[kg U]. The results enable to calculate the specific activities of the most important plutonium isotopes, as well as relative activities (^{239}Pu+^{240}Pu)/^{238}Pu, ^{241}Pu/(^{238}Pu+^{239}Pu+^{240}Pu). The recent quantities are experimentally detected by semiconductor alpha and liquid scintillation spectrometers. The respective diagrams together with experimental data can be used to determinate the type of reactor, where material of sample was produced. The theoretical results fit to sample, which was produced in PWR reactor (initial enrichment 3.28% of 235U, burn-up – 36 MWday/[kg U]) and with results reported in various reviews of the Chernobyl accident.

1. La Rosa J., Ghods-Espahani A., Veselsky J.C., e.a. (1991) Analyses of Pu some natural matrix materials. Vienna, IAEA-SM/90, 1, 457-465.
2. Beliajev B.N., Bibichenko B.A., Gromova E.A. (1991) Experimental investigation of spent nuclear fuel by RBMK-1000, Radiochimija, 4, 149-160 (in Russian).
3. Bowman S.M., Leal L.C. (2000) Origen-Arp: Automatic Rapid Process For Spent Fuel Depletion, Decay and Source Term Analysis, NUREG/CR-0200

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P2 – 101

DIAGNOSTIC OF HOT DENSE MATTER PRODUCED IN RELATIVISTIC HEAVY ION COLLISIONS

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In relativistic heavy ion collisions we expect the formation of quark-gluon plasma and other forms of colored collective matters. The verification of these new states of matter with extremely high energy density is based on different diagnostic procedures. One possibility is the investigation of the ratios of different particles, where the particles with low momentum are considered. Another way is connected to the modifications of the particle spectra at high momentum and the energy loss of the original high energy jets penetrating the produced color matter. In the talk we summarize the theoretical results based on recent SPS and RHIC experimental data and display the possible scenarios for the matter produced in central heavy ion collisions.

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PREFFISION NEUTRON MULTIPLICITIES AS A FUNCTION OF TKE OF FISSION FRAGMENTS OF ^{226}Th

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We analyzed the preffision neutron multiplicities as a function of total kinetic energy TKE of fission fragments. Correlation between pre-scission neutron multiplicity and TKE would supplement the understanding of fission dynamics, because variations in TKE can be associated with different elongations of scission configuration. The experiment was performed at the VIVITRON, Strasbourg. The reaction was $^{18}0 + ^{208}Pb$ at E_{lab}=78 Mev. The experimental set-up consists of six microchannel plate detectors (CORSET), which gave the informations about direction and the velocity of each fission fragment and of 83 module of DEMON detector, which were used to detect the neutrons emitted in coincidence with fission fragments. From the fission fragment mass distribution the two fission modes were separated. For each mode the deconvolution of pre- and post-scission neutron sources was carried out using the χ^2 procedure.

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PHYSICS EDUCATION AND WEB RESOURCES

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With the technological advancement, a lot of information is now available through electronic media. This information is vast and scattered. In this paper we have tried to organize the available resources on physics education on the web. Some suggestions have also included which can be helpful for the teachers of next generations.

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AN ATTEMPT TO RESTORE THE ATTRACTIVENESS OF PHYSICS STUDIES

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During the last decade prestige of physics university studies dramatically has declined in Lithuania. This was initiated by changes in political and mostly by economical changes in the country, collapse of industry followed by shrinking demand for graduates in science and especially in physics.

In Physics faculty of Vilnius university we tried to overcome this tendency by introducing a new programs combining physics with other fields of science introducing programs "Management of modern technologies", "Computing physics" "Telecommunications physics" is on the boundary between physics, informatics and modern telecommunications technology, economics etc. Above mentioned programs raised the number of first cycle students in Physics faculty more than twice We plan to continue this way establishing new programs combining physics and medicine, physics and environmental sciences etc. In that report some statistical data on physics curricula, subjects, assessment, grading etc. are intended to present.

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P2 – 105

TEACHING PHYSICS AT A DISTANCE: CHALLENGES AND SOLUTIONS

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The Open University is the largest university in the UK. Its 200 000 students are mainly mature students, studying part-time and at a distance. The remoteness of the students, and their wide range of prior qualifications, backgrounds and educational objectives present a number of teaching challenges, especially in an experimentally based subject such as physics.

This talk will review some of those pedagogic challenges and critically examine some of the responses that have been used to overcome them over the past thirty years of Open University teaching. Particular emphasis will be given to the way the responses have evolved as educational technology has developed, especially in the areas of practical work, assessment, multimedia activities and the widening of participation.

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P2 – 106

A MODEL FOR DIAGNOSTICS OF THE ACHIEVEMENTS OF THE STUDENTS, DEFINED BY THE STATE EDUCATIONAL STANDARDS, CONNECTED WITH THE FOLLOWING TOPIC "DIRECT CURRENT"

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The following work is the beginning of one research, which aims to value the achievements of the students, defined by the educational programme in physics for the 9th class, which deals with the topic "Direct current".

The tasks, on which the preparation and organization of such a research should respond, are pointed out. There are detail, standards to the achievements of the students, which is necessary on one hand, for adaptation to the different levels of comprehension and on the other hand for their adjustment in a way, suitable for a check by tests.

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PHYSICS "FOR OTHERS"

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Among my students of physics from Faculty of Mathematics and Physics, Charles University, three types may be distinguished:
- students of physics (Ph) supposed to have physics as their main job;
- students of informatics (In) at the 3rd course, to whom physics (namely electronics) may help in understanding their job;
- students of mathematics (M) at the 1st course, who may be employed to support some physical research.

There are some peculiarities tight to those types:
- some of M (but not all of them) know already calculus (needed for classical mechanics) from secondary school; anyway, all of M will be skilled in it at the end of 1st course;
- some of M and In hate physics from secondary school as an ugly collection of (strange) formulas;
- most of M and some of In feel approximating in physical models and calculations as something "plain", "dirty", "lack of accuracy and exactness";
- many of M an In feel physics as a theoretical construction without seeing practical connections to the real everydays world round us;
- they know (hope?) that physics will not be their "first line job".

My specially stressed goals are:
- to show the applicability of any part of physics we deal with; it means a.o.
- to make experiments or to show practical applications by photos, videos etc.;
- to mention as often as possible the values of physical quantities just discussed for objects round us;
- to suppress the need of memorising of formulas; e.g. students may use both textbook and their manuscripts by exams;
- to support their "physical feeling";
- to learn understanding physical text together with the ability to express it using own words and then in mathematical expressions.

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'ECOLOGICAL EDUCATION' PROJECT ACTIVITIES IN BULGARIA –INNOVATIONAL PHILOSOPHY IN THE PHYSICS TRAINING STRATEGY IN SECONDARY AND HIGH EDUCATION

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The following ecological projects are among the rich experience of the team to develop such activities:
Natural-scientific Ecological Expedition – 1997
Ecological Training for Leaders of Ecogroups – 1998
Initiative Bulgarian-Romanian Youth Corps "Let's protect our river together!" – 2000

The first two projects were financially supported by the Association of the German Free Universities and the third one – by the American foundation "Charles Steward Mott".

Last grade students from various secondary schools in Ruse as well as students at the Ruse University took part in all projects.

The particular moments, essential for the didactic of Physics and Physical Sciences, are:
Assimilated physical basis of the monitoring technology for air, water and soil

Precise measuring of basic monitoring parameters related to ecological tourist routes in the territory of Bulgaria (Protocols from the corresponding measuring are supplied in the publication)
Developed network of youth ecogroups in the Bulgarian towns of Ruse, Tutrakan, Silistra as well as in the corresponding Romanian ones: Gjurgevo, Oltenica, Kalarash. The network subunits develop, exchange and share ecological ideas and strategies; do researches concerning the preservation of the Danube river and its important wet zones. Basic aim in the followed strategy is harmonizing of the Bulgarian methods for monitoring with the European ones in order to reach the international standards. Environmental monitoring itself is being a fundamental part in topics of the education.
Worked out applied psychological methods for group researches, concerning physical methods of the ecological monitoring.

All the projects are entirely realized by students under the supervision of Ruse University docents.

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FROM KENDREW TO NEWTON: A JOURNEY TO THE CENTER OF PHYSICS

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For some years, the enrolment in physics has been steadily decreasing all over the world and now many physicists have been considering this problem earnestly. This is evident, for example, in the theme of Malvern Seminar of European Physical Society, Sept. 1999. Therefore, it is worth considering the question: Which factors contribute to this problem? The most crucial factor, I think, is the simultaneous existence of Aristotelian and Newtonian ideas among students, due to which their answers in the traditional exams sharply *contrast* with their answers in questionnaires of educators. This contrast has been confronting educators for about 30 years and no effective solution has been evolved, as yet. Why not? This question caught my attention about 20 years ago and compelled the initiation of the logical restudy of basic concepts of physics.

Eventually, I arrived at the conclusion that the persistence of Aristotelian ideas is due to the logical conflicts between concepts themselves. For example, the persistence of the tangential force, as the resultant force in case of uniform circular motion, is due to the logical conflict between the present treatment of uniform circular motion and the concept of work. Treatment of uniform circular motion and the law of parallelogram of forces also conflict logically. The global character of persistence of Aristotelian ideas is a compelling evidence of the fact that these logical conflicts have to be overcome in order to improve the understanding of subject and thereby help increase the enrolment in physics.

Therefore, for more than ten years, I am trying to draw attention of physicists – rather than educators – to these logical conflicts. For example, see my recent dedications to memories of Abdus Salam /1/ and Dennis Sciama /2/. The above description is very likely to create the impression that the author must be a trained physicist, now working in physics education.

But, in reality, I studied physics only for first two years of the 4-yr B.Sc. course, then switched over to Chemistry and Biology and finally completed M. Sc. in Biochemistry, in 1970. Then, from 1970 I started shifting towards *self-paced learning of physics*, though I was working for a Ph. D. in Biochemistry. Finally, in 1974, I gave up the research in Biochemistry, joined a junior college as a teacher of Chemistry and Physics and continued the efforts in problems in physics education, as my own mission.

This change could take place because of the inspiration received from Sir John Kendrew, through a long correspondence between April 1970 and 18 April 1997, the day he wrote me the last letter – a few months before his death on 23 August 1997. I am forwarding a photocopy of his last letter to the Editor of this journal. Being able to discuss some important matters of physics itself, with leading physicists like Salam and Sciama, is itself a kind of achievement, I suppose. So, on having done all this, I think, this is the most appropriate time to dedicate this note to the memory of my Respected Guru.

1. Sathe, Dileep V. [August 2001] Chemical Education International, V:2, N:1, item: AN-7, http://cssj.chem.sci.hiroshima-u.ac.jp/ctc
2. Sathe, Dileep V. [December 2001] COSPAR Information Bulletin # 152, p. 53.

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A CONCEPTION FOR INTENGRATED STUDY OF ASTRONOMICAL AND PHYSICAL KNOWLEDGE IN THE SECONDARY SCHLOOLS IN BULAGARIA

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According to the new curriculum Physical and Astronomical knowledge is included in a combined subject, called "Physics and Astronomy". Until this year Astronomy was taught as a separate subject in the last year of secondary education. The author of this abstract has participated in the preparation of the student book for the subject. The new educational situation in Bulgaria has created a necessity to work out a new conception for teaching Astronomical knowledge. The essence of this conception is to represent the structure of the physical theory in summary. As a summary it gives the opportunity of extrapolation in the field of Astronomy and its objects. Besides this method also gives the opportunity of growing Astronomical knowledge from the first to the last year of Physical education in the secondary school.

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TEACHING STUDENTS ON THE UNIVERSALITY OF THE LAWS OF PHYSICS IN THE UNIVERSE

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The canon of contemporary physical knowledge will be presented. Its two basic constituents are: the definition of the subject of physics and the set of the fundamental (nowadays) laws and theories of physics and its certain general characteristics [1].

The subject of physics is: 1° *the formulation of questions* „where", „when", „how" and „why" with regard to the phenomena of Nature and question „how much" with regard to the values of physical quantities describing these phenomena as well as 2° *the answering them*, taking into account that the answers of questions „where" and „when" have limitations following from the Heisenberg uncertainty principle. The questions „why" in the body of physics have – in spite of the admitted opinions – only the auxiliary character, and their role in physics is connected with the hierarchy of the laws of physics.

As concerns the laws of physics themselves, they are formulated in the language of mathematics and say „how" the phenomena of Nature are going on, but neither „where", nor „when", nor „why", nor „how much". Therefore the laws of physics are universal in the Universe, but they do not explain the mechanisms of the phenomena.

To illustrate the universality of the laws of physics in the Universe the up-to-date set of the fundamental laws and theories of physics and its certain general characteristics will be presented and discussed. With the same aim it will be shown that the application of our physical knowledge to the interpretation of the phenomena observed in the Universe has extremely enriched our knowledge both about its current state and about its origin and evolution. On the other hand, the observations of the Universe have taught us new surprising aspects of physics, such as e.g. the existence of dark matter, black holes or vacuum energy [2]. Let us recall several aspects of the study of the Universe (as: special and general theory of relativity, cosmology, nuclear astrophysics, gravitational lensing, search for extra-solar planets, the likelihood of life in the Universe etc.), which are simultaneously the examples of application on the scale of the Universe of the laws of physics known and formulated on Earth.

All the problems mentioned above should be lectured on or taught on different levels of education (secondary school, university etc.). The level of popularization in the teaching process should always be adapted to the student's level. For instance, the work leading to the popularization of the complete canon of contemporary physical knowledge mentioned above makes a challenge of our time for the sake of the didactics of physics at different teaching levels.

[1] J. Warczewski, Remarks on the fundamentals of the didactics of physics, Postępy Fizyki (Progress in Physics; the Journal of the Polish Physical Society), 50(4), 1999, pp. 194- 203, in Polish
[2] Europhysics, special issue „Physics and the Universe", 32/6, 2001

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SECONDARY SCHOOL STUDENT'S CONCEPTUAL AND CONVENTIONAL KNOWLEDGE IN MECHANICS AND SOME SOCIO-ECONOMIC PARAMETERS

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In the process of establishing its independency, Republic of Macedonia went through many crisis and changes. Among others, young people and their main task, education, were also influenced by these changes.
This is a part of a bigger research tending to find the direction in which the changes and reform in education, especially in physics education should be done. It will give information on many issues. In this report we are focused only on conceptual versus conventional knowledge and how it is influenced by some of the socio-economic parameters.

Large sample was taken (997 students were tested) in order to avoid the shortcomings of the multiple-choice questions (1).

We discovered very high correlation between scores of the conceptual and conventional questions. About 78% of the students achieved roughly equal scores on both conceptual and conventional questions, which is very good result compared to other authors (2). Average score for the conceptual answers is 4.3 (out of 10) and 4.2 (out of 7) for conventional answers.

The gender analysis did not reveal significant differences. With multiple correlations, gender differences appear in other social parameters (3).

The students from the gymnasiums natural sciences and mathematics branch had higher scores then the ones from gymnasiums general branch, as it was expected. But, the average scores show the students both from the general gymnasiums and science schools did not pass the conceptual test.

Analysis on education degree of the parents, home library, rural and urban environment was also done and correlations with the scores were found.

New ways of teaching should be introduced in order to improve the understanding of physics. Computers and collaborative learning has given positive results (4).

G. Tikhomirov Yu.V. (2000), A method of computerized assessment in introductory physics Eur. J. Phys. 21, 211-216
(2) Mazur E., Peer Instruction A User's Manual (Prentice Hall, Upper saddle River, New Jersey)
(3) Neathary M.F. (1997), Elementary and secondary students' perception towards science: correlations with gender ethnicity, ability, grade and science achievement. EJSE Vol.2, No.1
(4) Tao P.-K., Gunstone R.F. (1999), Conceptual change in science through collaborative learning at the computer. Int.J.Sci.Educ. Vol.21, No.1, 39-57

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THE REACTION KINETICS OF THE TESTOSTERONE – ANTITESTOSTERONE ANTIBODY SYSTEM BY RIA METHOD

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The affinity constants, the rate constants of reactions and the optimal time to achieve a chemical equilibrum – representing the immunogenic qualities of antibodies and antigens – are essential in establishing of the optimal conditions for RIA (radioimmunoassay) analyses. The present paper evaluates these parameters to be applied for the radioimmunoassay of testosterone (1-4).

Samples of antitestosterone antibody (100 μl) and testosterone – ^{125}I were completed up to 1 ml with phosphate buffer 0,05 M, pH 7,4 (containing horse serum 10 mg/ml) and incubated at different intervals of time. The immune reaction was stopped with 1 ml of 50% ammonium sulphate and the precipitate (which contains the immune complex) centrifuged at 2500 g for 30 minutes. The supernatant was discarded and the radioactivity in the precipitate was measured at γ-counter (82% efficiency).

The measurements of kinetic parameters K_{+1}, K_{-1} for testosterone-antitestosterone antibody system in the above exposed conditions lead to an equilibrum constant (affinity constant) of $6{,}9 \times 10^5$ l.mol^{-1} for this system.

The optimal minimal time for reaching of chemical equilibrum was about 60 minutes.

G. J.Fleeker, *J Assoc Off Anal Chem*, 70:5 874-8 (1987).
2. D.Knopp, P.Nuhn, H.J.Dobberkau, *Arch Toxicol*, 58:1 27-32 (1985).
3. Flanagan RJ, Ruprah M, *Clin Chem*, 35:7 1342-7 (1989).
4. Agasan AL, Stewart BJ, Watson TG, *J Immunol Methods*, 28 177:1-2 251-60 (1994).

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THE PHYSICAL EVIDENCE OF THE EFFECT OF MICROWAVES INFLUENCE UPON BIOLOGICAL SYSTEMS: DATA OF SPECTROSCOPY, HOLOGRAPHY AND LANGMIUR-BLODGETT TECHNIQUE

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Last years the study of microwave (MW) electromagnetic field action upon biological systems is a subject of great interest due to well-known biological and therapeutical effects. Despite a growth of information on biophysical experiments, there exist a number of problems in fundamental interpretation of the data obtained which often remain controversial.

Here we present experimental evidence of the MW-induced changes in physical and chemical characteristics of the biological molecules. Under the application of MW field we have registered: 1) with holographic interferometry changes in refractive index of model solutions; 2) with optics and spectroscopy, the changes in H-bonds in nucleic acids and vibrations modes of NH^{3+} and COO- terminal groups of amino acids which is responsible for the interaction in biochemical reactions; 3) the drastic changes in the formation of Langmuir-Blodgett layers; 4) with plasmon spectroscopy changes in organization of protein layer and antigene-antibody reactivity. The microwaves influence the orientation of the molecules in solution and transformation of H-bond nets. Other possible mechanisms of MW influence the biological molecule are discussed.

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HYDROPHOBIC/HINGE-FORCE MODEL FOR PROTEIN FOLDING EVIDENCE AND CONSEQUENCE

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A major problem in protein folding is the understanding of how a 3D structure can arise from a 1D sequence information. A simple model for solving this is proposed, in which mainly hydrophobic effects prestructure elements (PE) in partially folded secondary structures, turns and loops. These may fold, by the same mechanism, in relatively few loosely packed structures; with a degeneracy of the order 100. Of these only one contains the correct basis for forming the native structure. The hypothese is that the protein already in the extended state has a drive towards the native one. It is proposed that the (PE) are connected by hinge forces, coded linearly in a local sequence, which provides a weak preference for optimal relative positioning, and hence lifting the degeneracy. Evidence from recent computer simulations and de Novo proteins studies supports this idea. Statistical consequences are outlined.

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CATIONS CONTROLLED RELEASE IN SIMULATED BIOLOGICAL ENVIRONMENTS

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The release rate of cations from $xCaO\cdot(90\text{-}x)P_2O_5\cdot 10K_2O$ glasses (x 35 mol %) in simulated biological media (decationized water, physiological serum and chlorine acid, pH =1.5), at room temperature, in static regime during 24 hours was investigated.

The data indicates that the corrosion behavior of the samples depends on the hydrogen concentration in solutions and on glass composition and local structure.

In the investigated time range one observes two leaching stages relative to the incipient dissolution. In the first stage the lowest release rate is obtained from the potassium-phosphate matrix (x = 0) in decationized water while for the whole time the lowest leaching rate is recorded again in decationized water but from the sample with 5 mol % CaO.

When the substitution of P_2O_5 by CaO exceeds 50% the cations release changes the rates in the three simulated biological media.

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ENERGY SITES, INTRAMOLECULAR ELECTRONIC PROCESSES AND DAMAGE OF DNA

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The absorption, fluorescence, and phosphorescence of DNA in the range of 4,2-300 K and its UV-damage were investigated in the range. The positions of singlet and triplet levels of DNA-bases were determined and possible processes of energy transfer in DNA were examined. The experimental data show that singlet excitations migrate through the distance of DNA 10-20 base pairs. According data obtained at least the distance of four base pair length sequence can be overcome by triplet excitations in natural DNA. On the other hand, the spectral investigations show that in model synthetic macromolecule which consists of 12 base pairs with determined order of energy levels triplet excitations spread directly from the first link to the end link upon selective excitation.

The number of experiments on UV damage of DNA, model compounds (pdA, pdT, pdG, pdC), and specially created the functional DNA – type macromolecule were carried out. The examining of these and previous results proves that positions of singlet and triplet energy sites in DNA are not random. Their displacement and intramolecular electronic processes which take place in DNA lead to phenomenon of the DNA self protection.

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COMPUTATIONAL TECHNIQUES IN NEUROSCIENCE

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In our presentation we briefly review some of the main computational methods used in the neurosciences and give examples of their applications. Tools presented here enable us to describe the performance of neural systems at very different levels of the organization from single cells via network to system level.

Single-cell models: Compartmental technique

Compartmental modeling technique is now often used to investigate the electrogenesis, propagation and control of action potentials and more generally, the different spatiotemporal patterns at cellular level. Because of the development of anatomical and electrophysiological methods both the axonal and dendritic branching patterns and the intrinsic physiological properties of different types of neurons became the subject of studies, and data to be incorporated into detailed models started to be available.

Both single- and multicompartmental models exist. The crucial assumption behind a single-compartmental model is that the whole cell can be characterized by a single membrane potential. The spatial distribution of channel densities and kinetics have been taken into account by using multi-compartmental models.

Multi-Level Models of Neural Networks

A rather large subset of brain models takes the form of networks of intricately connected neurons in which each neuron is modeled as a single-compartment unit whose state is characterized by a single ``membrane potential''; anatomical, biophysical and neurochemical details are neglected. Such neural network models are considered, at a certain level of description, as three-level dynamic systems by taking into account the activation, threshold and synaptic levels.

Statistical Neurodynamics

The behavior of large networks of neurons may be studied by population approaches. Just as collective phenomena emerging in physical systems made from large number of elementary components (spins, molecules, etc.) are treated by statistical mechanics, analogously have statistical dynamical descriptions of neural populations been established. Some applications are briefly reviewed.

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STUDY OF ROTARC PLASMA REACTORS STABILITY BY MEANS OF ELECTRIC DISCHARGE FREQUENCY ANALYSIS

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Glidarc discharge is an auto-oscillating periodic phenomenon developing between at least two electrodes that are submerged in a laminar or turbulent gas flow. The gliding discharges allow high specific throughputs in the reaction zone, which generally largely exceed other chemical methods, including electrochemical and thermal ones. The present work is dedicated to the comparative study of hydrogen production by methane steam reforming using a three channels rotarc reactor. The effect of discharge frequency on reactor's functioning (stability) and on the chemical parameters (e.g. conversion, selectivity, energy cost) has been determined in order to optimise the performances. The main characteristic frequencies appearing during the reactor's exploitation were determined analysing the data tension vs. time by means of Fourier transformed. According to the results, the discharge frequency can act as an important factor on the selectivity and on the energy cost of the glidarc reactors.

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CHARACTERISTICS OF A LASER BEAM AFTER PASSING THROUGH TWO CRYSTAL PLATES

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The theory of the dependence of the azimuth of oscillations of the transmitted light through two plane-parallel plates of uniaxial crystals, on the incident angle and on the thickness of plates as well, is presented in this work. System of calcite-beryl with respective refractive indices n_o = 1.6584, n_e = 1.4864 and n_o = 1.5740, n_e = 1.5674, for the incident light with wavelength l = 589 nm and with azimuth of oscillations y_0 = 300 is numerically calculated. The curves obtained show superposition of two oscillations. Increasing the angle of incidence a0, oscillations become shorter. Numerical analysis is carried out for the case when the thickness of calcite plate is kept constant (1 mm) whereas the thickness of calcite plate is changed taking the values 0.1, 0.2, 0.5, and 2 mm, and the same for the beryl plate. Characteristic behaviour of the oscillations appears, not only in the initial state, but also related to the duration of oscillations. It is shown that a complete os cillation of azimuth corresponds to the change of the thickness of the beryl plate by 2×10^{-4} mm.

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LIGHT INDUCED FREDERIKS TRANSITION IN WAVEGUIDES AND RESONATORS WITH LIQUID CRYSTAL CORE

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We consider the monochromatic light wave which propagates in nematic liquid crystal core of round cylindrical or rectangular waveguide. The waveguide surface is assumed to be metallic one. If the light wave is polarized perpendicular to nematic director and intensity of the light field exceeds some threshold value the so-called light-induced Frederiks transition (LIFT) takes place and nematic director changes its direction [1]. That leads to the change of conditions for the propagating light wave and as a result to the change of such its characteristics as wave vector value, dispersion law, group velocity and so on. We have studied the dependence of LIFT threshold value on the type (TE and TM) of light wave and its frequency at the different (planar and homeotropic) boundary conditions on the waveguide surface as well as on the director anchoring energy with the waveguide surface and the waveguide size. It is shown that LIFT threshold value increases with increasing of light wave frequency for all the types of light waves and boundary conditions except for the TM-wave at the planar boundary conditions for nematic director. In last case the LIFT takes place only when the light wave frequency exceeded some critical value. Both the single-mode and two-mode regimes for the light field in a waveguide were studied. In this connection it was shown that LIFT threshold decreases with increasing of the portion of light energy contained in the second (with less value of wave vector) light mode except for the already mentioned case of TM-mode at planar boundary conditions. We have also studied the possibility of waveguide blocking caused by LIFT in the case of the low-frequency waveguide modes. The dependence of LIFT threshold value on the parameters of the metallic rectangular resonators are studied as well.

[1]. B.Ya.Zel'dovich, N.V.Tabiryan, Yu.S.Chilingaryan, ZhETP, 81, 72 (1981).

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TOWARDS ACHIEVING AN X-RAY FABRY PEROT RESONATOR: FIRST EXPERIENCE AND RESULTS

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Fabry-Pérot resonators are indispensable to modern visible-light optics. Such instruments have been used over the 20th century to perform high-precision wavelength measurements. High resolution instruments of this kind would also be useful for electromagnetic radiation in the x-ray spectral range. A spectral resolution in the μeV range could be achieved. They could be applied in metrology to bridge optical and x-ray (or γ-ray) wavelengths. They could be used as interference filters of very high spectral resolution for studying, e.g., dynamics of solids, liquids, polimers, or macroscopic biological molecules. Up to now x-ray resonators remain an exciting and challenging unsolved problem. The current studies are aimed at creating a test device and studying the physics of x-ray resonators.

The main components of a Fabry-Pérot resonator are two mirrors of high reflectivity arranged parallel and separated by a gap. The system becomes transparent despite the high reflectivity of each mirror when the resonance condition for a standing wave formation in the gap is fulfilled. The transmission resonances can be observed, among other possibilities, by observing the time response of the resonator.

Mirrors of high reflectivity are a pivotal element of x-ray resonators. Bragg diffraction from crystals at normal incidence is used. Crystals with cubic symmetry, like Si, suffer from low reflectivity at normal incidence. The latter is due to multiple beam Bragg diffraction, which originates in crystals of cubic symmetry whenever the Bragg backscattering conditions for the incident radiation is fulfilled. Hexagonal sapphire (Al_2O_3) crystals are almost free from this drawback. However, on average they unfortunately have lower quality than Si crystals. High quality sapphire mirrors have been selected by using x-ray topography and reflectivity measurements.

X-ray resonators with mirrors of different thickness were tested. The time response of the resonator was measured with a detector of 120 ps time resolution. The observed time response is a decaying exponential function with superimposed oscillations. The thicker the mirrors and accordingly the higher their reflectivity the longer is the observed decay time.

To obtain the exponential decay with the longest decay time, the mirrors had to be adjusted parallel with sub-μrad accuracy and the temperature of the mirrors had to be kept equal to within 10 mK.

The longest response time observed 0.9 ns corresponds to an energy width $\gamma \leq 0.73$ μeV of the transmission resonances. The long response time or alternatively the large number of observed multiple reflected beams are the necessary conditions for the formation of sharp

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interference resonances. Newly performed experiments allow to state that the observed multiple reflections do interfere with eachother.

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[1] Shvyd'ko, Yu.V. and Gerdau, E.: 1999, *Hyperfine Interact.* 123/124, 741-776
[2] Chen, W.M., McNally,P.J., Shvyd'ko, Yu.V., Tuomi, T., Lerche, M., Danilewsky, A.N., Kanatharana, J., Lowney, D., O'Hare, M., Knuutila, L., Riikonen, J. and Rantamäki, R.: 2001 , *Phys. Stat. Sol. (a)* 186, No.3, 365-371
[3] Liss, K.-D., Hock, R., Gomm, M., Waibel, B., Magerl, A., Krisch, M., and Tucoulou, R.: 2000 *Nature* 404, 371.

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FRAUNHOFER DIFFRACTION DUE TO GRATING WITH SINUSOIDALY FORMED APERTURE BOUNDARIES

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A new type of two-dimensional diffractive optical element, with apertures bounded by two conjugated systems of sinusoides shifted to each other in amplitude direction, is proposed. Expressions for the wave and intensity distribution are found and they were used to make the three-dimensional graphs for diffractive optical elements with nine and twentyfive apertures. The photographs of the equiintensity distribution in the focal plane of the lens are given also.

[1] M. R. Taghizadeh, J. Turunen, Synthetic Diffractive Elements for Optical Interconnection, Optical Computing and Processing, vol. 2. No 4 (1992)221.
[2] Lj. Janicijevic, S. Topuzoski, M. Jonoska, Diffraction Characteristics of an Aperture with Cosine Pearl Form, Bulgarian Journal of Physics 27 Supplement 2 (2000)175.

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COHERENT MANIPULATION OF RUBIDIUM ATOMS IN A MAGNETO-OPTICAL TRAP

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Coherent manipulation of atoms without heating them in a process of changing their velocity or position is an important problem during transportation of atoms between different stages of a laser cooling system and other applications, where conservation of the atomic phase is an important requirement.

We present here results of theoretical and experimental investigation of coherent interaction of a sequence of short laser pulses with chirped frequencies with Rb^{85} atoms in a magneto-optical trap (MOT). The aim of the analysis is to determine optimal parameters of the laser pulses for effective coherent mechanical momentum transfer from the counter-propagating frequency-chirped laser pulses to Rb atoms in the MOT. The interaction with the laser pulses to be coherent, their durations have to be shorter than relaxation times (τ) of the atomic system, in our case being τ = 27nsec.

According to the scheme of proposed interaction, the first laser pulse produces excitation of the multilevel system of the hyperfine levels of the $5S_{1/2}$-$5P_{3/2}$ transition. The next laser pulse, which arises from reflection of the first one from a mirror and propagates in opposite direction, hits the excited Rb atom and stimulates its transition to the ground states. This sequence of excitation and de-excitation is repeated by all pulses from the laser train. In the ideal case of 100% probability of transition of population of the Rb atom from the ground states to excited ones and vice versa, the atom receives momentum equal to $2\hbar k$ during interaction with each pair of counter-propagating pulses, in direction collinear to propagation of the laser pulses.

One of the ways to achieve an effective, near 100% transition between the ground and excited states in the case of a two-level atom is to use short laser pulses with chirped frequency in the adiabatic passage (AP) regime. In the case of multilevel quantum systems the situation is more complicated because of presence of combination of different configurations (Λ-, V-, ladder-) of multilevel quantum systems. A numerical simulation of Bloch equations was performed to analyze the interaction of Gaussian laser pulses with linear frequency chirp with the multilevel hyperfine structure of the $5S_{1/2}$-$5P_{3/2}$ transition in Rb^{85} atoms. One of the main results of the analysis is, that the interaction of a frequency chirped laser pulse with the multilevel Rb^{85} system is in principle, similar with the interaction with an effective two-level atom, when the condition of the AP regime of interaction takes place: $R \times \tau \geq 1$, where R is the peak Rabi frequency.

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HEISENBERG-LIMITED INTERFEROMETRY USING N-PORT ANALYZERS

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A standard two-path interferometer whose output ports are fed into a balanced N-port analyzer creates a new class of interferometers. Such an interferometer should allow to simultaneously circumvent several problems currently hampering the observation of the Heisenberg-limit in multiparticle interferometry. For states with at least N particles the proposed setup yields an N-fold reduction of the observed de Broglie wavelength with perfect visibility. The proposed setup is surprisingly robust against common experimental imperfections.

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CASIMIR FORCE IN LAYERED SYSTEMS

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The Casimir effect in a general multilayered system is considered identifying the Casimir force in a layer with the net vacuum-field pressure in the multilayer with respect to that in the corresponding infinite medium. Using the properties of the field operators as emerge from a recently developed scheme for quantizing the electromagnetic field in the presence of absorbing bodies and a convenient form of the Green function for a multilayer, the Casimir force in a lossless layer of an otherwise absorbing multilayer is straightforwadly derived. The resulting expression depends only on reflection coefficients of the surrounding stacks of layers and is of the same form as that obtained by the (surface) mode summation method for a completely lossless multilayer by Zhou and Spruch [Phys. Rev. A 52, 297 (1995)]. Owing to the recursion relations which the generalized Fresnel coefficinets satisfy, this result can be applied to more complex systems with planar symmetry. This is used to consider in more detail the Casimir force on a dielectric (metallic) slab in a planar cavity with realistic mirrors.

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DIFFRACTION OF APERTURE ARRAYS FORMED BETWEEN TWO CONJUGATE COSINE-CURVED BOUNDARIES

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Between two conjugate cosine-curved boundaries, seven types of aperture arrays can be formed.

In this article the wave and intensity distribution in process of Fraunhofer light diffraction are calculated, and diffractograms for all seven types of aperture arrays are experimentally realized.

The central element, that is periodically repeated in each array separately, can be taken as a structural element of two-dimensional grating.

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HIGH INTENSITY, PULSED, SLOW POSITRON AND NEUTRON SOURCES AT INFN – FRASCATI

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The usefulness of low energy, high average intensity electron beams for production of secondary beams (like neutrons, slow positrons, high power FEL, etc.) is well known since many years, although in the past it has always suffered from the lack of power-effective accelerating structures. The rapid, impressive development of Superconducting RF cavities in the last few years has brought about a significant improvement in this field and the realization of a national facility for extensive applied physics studies, built around an electron Linac, seems now quite possible. Such an opportunity has been grasped by some developing countries, like South Korea, but also by some of the most advanced ones, like Germany and Russia, while others, like Japan and the United States, are still intensively using their already existing facilities. It is firmly established that neutron and slow positron beams deriving from primary electron beams constitute very useful investigation tools, complementary to the Synchrotron Light and Free Electron Laser (FEL) beams.

In this paper, the scientific case for neutron and slow positron beams in the LNF area is summarized

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VIRTUAL LABORATORIES – MODERN TRENDS IN PHYSICAL EXPERIMENT

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Development of modern information technologies and use Internet in scientific process have created the new form of research-remote experiment. One from the major parties of development remote experiment is creation of laboratories of remote access, which allow to use in a remote mode the information and laboratory resources, unique and expensive equipment. Besides they also allow to avoid unnecessary duplicating of the labware, that speaks about a direct economic efficiency of introduction of new information technologies in scientific process.Such approach allows to unit the experimental installations and contributors frequently located in different regions of the world. So the virtual laboratories can be created. The successful realization of such idea is possible, for example, for geophysics and space researches. It is planning in frame of these projects to create the model of center coordinating the process of the remote experiences. The experimental equipment of scientific institutes of a Russian Academy of sciences will be used. The United Physical Society of RF executes these activities now.

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AIM – CENTER FOR APPLICATION OF ION BEAMS IN MATERIALS RESEARCH

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The Center for Application of Ion Beams in Materials Research (AIM) is an open facility of the Institute of Ion Beam Physics and Materials Research in the Forschungszentrum Rossendorf e.V. (FZR) in Germany. It was established to provide access for researchers to the Rossendorf installations, under the Access to Research Infrastructure Activity of the European Community. The aim of the research activities of AIM is to contribute to the development of European materials research by using the widespread possibilities of ion beam techniques. Basic research is combined with the development of technological applications. Technical process development is accompanied by studies which improve the understanding of basic mechanisms. The AIM is devoted to the application of ion beams for the modification and the analysis of near-surface layers of solids. For this purposes a broad spectrum of ion beam apparatus in the energy range from 10 eV up to several MeV, analysing and preparation methods, thin film deposition by ion beam or plasma assisted deposition, beamline ion implantation of materials, plasma source ion implantation (PSII), application of high energy (MeV) accelerators, experimental stations for the simultaneous use of two ion beams and use of focused ion beams are available. All existing experimental facilities are open for external users.
7 beam lines for ion beam analysis (2x RBS, ERDA, external proton beam – PIXE, NRA, nuclear microprobe, high-resolution RBS with magnet spectrometer)
three ion implanters (200 kV and 160 kV high current implanters, 500 kV implanter)
2 devices for plasma-based ion implantation (200-liter chamber, metal PBII)
2 devices for ion beam assisted deposition (IBAD)
Fine-focused ion beam machine IMSA-100

AIM Specialities are
simultaneaous double implantation with target station combining 3MV tandetron and 500 kV implanter
ion beam analysis with ERDA at Nuclear Microprobe
real-time in situ analysis with
low energy ion beam processing (< 2 keV) combined with in-situ heavy-ion ERDA,
gaseous ion implantation (< 20 kV) combined with in situ RBS and heavy-ion ERDA,
high energy implantation (from 3 MV tandetron or 500 kV implanter) combined with in situ high resolution RBS ,
ion beam assisted deposition combined with in situ optical diagnostics (ellipsometry, infrared absorption) and in situ film stress measurement.

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THE EUROPEAN SPALLATION SOURCE ESS, A REVOLUTIONARY STEP FORWARD

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The European Spallation Source (ESS) is the recognized future flagship of Europe's neutron landscape. ESS steps beyond comparable pulsed neutron spallation sources in the US and Japan. Its higher power translates directly into more intensity and ESS has with two complementary targets for 50 Hz short (1.4 microsec) and 16 Hz long (2 msec) pulses of neutrons. Each target station accommodates a complementary set of moderators and serves 24 beam lines. ESS will create the best conditions for a very wide range of scientific fields, from physics over soft matter, materials design, chemistry, life science, earth science and archaeology research. A glimpse of its scientific potential and a facility description is presented in a poster cluster. Just recently, many hundred scientists from across Europe joined together and presented a strong and well-respected scientific case for the ESS and a feasible technical design study. It is now time for the European science ministers to decide on the funding and go ahead of this exciting and enormous 1.5 M-EUR project. ESS is a revolutionary step forward to brighter neutron sources and will be a venerable cornerstone of the European Research Area.

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ELECTRONIC EXCITATIONS STUDIED WITH INELASTIC X-RAY SCATTERING

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The appearance of third generation synchrotron radiation sources having unprecedented flux and the improvements in X-ray optics have made possible spectacular developments in the field of inelastic X-ray scattering (IXS). A collection of high-resolution photon in photon out spectroscopies performed with hard X-rays, which include X-ray Raman spectroscopy, high-resolution X-ray absorption and emission spectroscopies and resonant inelastic X-ray scattering, are on the way to become routinely available for studying the local electronic stucture of bulk condensed materials. We present the capabilities of the IXS techniques applied to the investigations of electronic excitations with recent works done at the European Synchrotron Radiation Facility.

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QUANTUM VORTEX SHEET

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It is well-known fact, that chaotic quantum dynamics of a single particle can be pictured as a classical turbulent fluid, which shows regions of singular behaviour [1]. Similarily, some ordered systems exhibit existence of regions (topological defects called vortices), within which their parameters of order show singular behaviour. We assume that the system is described by Schroedinger equation with a potential V(r)=0 everywhere except of infinitely thin sheet. With help of fractional calculus, we show that solution of the problem can be given in terms of fractional spherical harmonics [2] with half-integer quantum numbers.

[1] M. H. Chang, T, Chiueh, C. R. Lo, Phys. Rev. E59, 67 (1999)
[2]Z. Bak, Nuovo, Cimento, 20D, 1345 (1998).

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EXPERIMENTAL INVESTIGATION OF QUANTUM CHAOS IN ONE-DIMENSIONAL STRUCTURES

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The spectra of microwave graphs simulating one-dimensional quantum graphs [1] are measured for the frequency range 0.05 MHz – 18.5 GHz.

Experimentally quantum graphs are simulated by a set of microwave cables that are connected to form a tetrahedron. To avoid level degeneracies the lengths of the cables are chosen to be not rationally related.

The measured spectra are analyzed and the spectral statistics: integrated nearest neighbor spacing (INNS) distribution and the spectral rigidity $\Delta_3(L)$ are compared to the predictions of random matrix theory (RMT) for the Gaussian orthogonal ensemble (GOE) and the Gaussian unitary ensemble (GUE).

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T. Kottos and U. Smilansky, Quantum Chaos on Graphs, Phys. Rev. Lett. 79, 4794 (1997).

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NON-EXTENSIVE STATISTICAL ASPECTS OF CLUSTERING PHENOMENA IN NATURE

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Some recent developments concerning an application of the non-extensive Tsalis statistics to describe clustering phenomena is briefly presented. Cluster formation is a common feature of a large number of physical phenomena such as molecular physics, nuclear and astrophysics, condensed matter and biophysics. Common to all these is the large number of degrees of freedom, thus justifying a statistical approach. However the conventional statistical mechanics paradigm seems to fail in dealing with clustering. Whether this is due to the prevalence of complex dynamical constrains, or it is a manifestation of new statistics is a subject of considerable interest, which was intensively debated during the last few years. Tsalis conjecture has proved extremely appealing due to its rather elegant and transparent basic arguments. We present here evidence for its adequacy for the study of a large class of physical phenomena related to cluster formation. An application to nuclear multifragmentation is presented.

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HEAT CAPACITY OF IDEAL GAS OF ANHARMONIC OSCILLATORS

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The vibrational contribution to the heat capacity of ideal molecular gas, with anharmonic potential energy, is investigated. Expressions are derived for the vibrational energy levels of a piecewise linear harmonic oscillator with Dirac delta function barrier and given coefficient of impenetrability. Analyses were made of the dependence of the heat capacity on temperature for different anharmonic potentials as well as different coefficients of barrier impenetrability.

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DIFFRACTION CHARACTERISTICS OF THE VICSEK – 3 FRACTAL

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The subject of diffractional investigation are the binary plane fractal gratings, constructed by inflation method of fractalization of the third Vicsek generator (out of the four proposed generators, modeled to simulate diffusion processes, cristal growth and cluster congregations). All expressions needed for and resulting from the theory, are determined for the general order fractal grating. The intensity distribution of the diffracted field enables the determination of the fractal dimension and the mass of the Vicsek – 3 fractal. The theory is supported by the diffractograms of the first two fractal orders.

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THE RELATIVE LYAPUNOV INDICATORS: AN EFFICIENT AND SIMPLE METHOD OF CHAOS DETECTION

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A simple and efficient method has been recently introduced for determining the ordered and chaotic nature of orbits in Hamiltonian dynamical systems (Sandor et al, 2000). This method is based on the calculation of the difference between the finite-time approximation of the maximum Lyapunov characteristic exponents of two neighbouring orbits, therefore the calculated quantity is called the Relative Lyapunov Indicator (RLI). It has been shown by using orbits from 2D and 4D Hamiltonian (symplectic) mappings, that the time-evolution of the RLI indicates the regular or chaotic behaviour of an orbit very efficiently. As a possible application of the method, the dynamical stability maps of some known exoplanetary systems have been presented.

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INTERNAL PAIR PRODUCTION IN ALPHA- AND BETA-DECAYING NUCLEI

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The measurement of the internal electron-positron pair production in the alpha-decay of ^{210}Po, ^{239}Pu and ^{241}Am and in beta-decay of ^{32}P and ^{54}Mn has confirmed that this higher-order effect is much less intense than the basic decay process. Electron-positron pair originates only about once per 10^9 decays. The number of electron-positron pairs was estimated by counting annihilation photons. The measurement of the internal pair production is a typical experiment for low-level gamma-ray spectrometry. For this reason in the measurements single Ge(Li) or HPGe and coincidence Ge(Li)-NaI(Tl) and HPGe-NaI(Tl) spectrometers were used. The detectors were located in the low-level background shield. The obtained results are compared with the experimental and the theoretical results of other authors.

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ELECTROCHEMICAL EXPERIMENTS FOR FORMATION OF NANOSTRUCTURED OR POROUS STRUCTURES ON A III-V SEMICONDUCTOR

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Nowadays nanostructures and nanoparticles are widely investigated also in solid state physics and also in the field of semiconductors. Unique properties of such structures especially important for the optoelectronics. Mainly various epitaxial methods and special growth conditions are applied. Here we try another approach.

Electrochemical processes are important not only in the everyday life as spontaneous effects (e.g. corrosion), but they are intentionally used in many fields including also semiconductor surface treatment. Such treatment is "classical" in the characterization of carrier concentration depth distribution. Also defect, mainly dislocation reveal and determination and selective etching of different layers are possible with such methods.

In this work the effect of the electrochemical attack on the surface was investigated applying various conditions to differently doped GaAs (100) surfaces, both bulk and epitaxial ones. First I-V characteristics were studied to find conditions beyond the conditions of (nearly) polishing etching, which is applied in the case of concentration profilometry. The aim was just the contrary to prepare nanostructured or porous textures and morphologies on such surfaces, since it is known that porous or nanostructured media can give a shift of luminescence peaks toward higher energies.

Various aquaeous media were used as electrolyte (basic and acidic ones, using KOH, HCl, H_2SO_4, KCl, tiron) and a great variety of GaAs crystals undergo such experiments. As for the electrical conditions, both polarities, various current densities and various integrated charge values were used. The influence of the illumination was also studied.

The main results are numerous depending on the conditions: selectively etched defects, orientation dependent wall structures, sulphur and auripigment deposition and disordered morphologies with possible nanowires, etc. Step by step and microscopic in situ monitoring of the surface demonstrated the indispensable role of defects at the starting phases of the electrochemical etching.

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IMPROVED SURFACE AND INTERFACE PROPERTIES OF InP

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The main drawback is, InP has high density of surface states that limits the rapid development of InP based devices. A great deal of research has been devoted for possible ways to improve the properties of the surfaces. The motivation of this present investigation is to develop new ways of surface preparation and effective passivation schemes to reduce both the number of defects and the surface state density of InP. <111> oriented, undoped n-type ($n = 2x10^{16}$ cm^{-3}) bulk InP single crystals have been grown by LEC technique and taken for the investigations. A new polishing solution, consists of $HBr:K_2Cr_2O_7:H_2O$ (BCA) in which the diffusion process is well behaved and better controlled, has been realised. The polishing parameters have been optimised to give subsurface damage free, well-defined InP surfaces and are compared with Bromine-Methanol (BM), most commonly used polishing solution for InP. The quality of the BCA polished surfaces have been analysed using low temperature PL and HRXRD measurements. For BCA polished sample, the integrated PL intensity of the exitonic peak is increased by a factor of 7 as compared to BM polished samples. The XRD peak of BM samples show an additional peak, very close to the main peak due to porous nature of the surface whereas very sharp single peak (width: 25 arcsec) has been observed for the BCA samples. Enhanced PL intensity and a smaller width of HRXRD peak ascertain good quality of the surface polishing. CdS has been used to passivate the InP surface to further reduce the surface state density. PL measurements of the CdS passivated InP samples shows a further increase in PL intensity by a factor of 4 times when compared to unpassivated BCA samples. Anodic oxidation of InP has been carried out at room temperature using AGW electrolyte to prepare MOS structures. By employing this method, introduction of interface states has carefully been avoided. By varying pH of the electrolyte, the conditions for the growth of stable oxides on InP have been optimised and the surface morphology has been verified with AFM measurements. The effect of CdS passivation and formation of anodic oxides on InP has been investigated in detail using XPS technique. Chemical compositions and their depth distributions were also analysed by XPS combined with in situ Ar^+ ion sputtering to analyse the interface. XPS spectra of as-grown anodic oxide of CdS passivated InP shows the formation of high resistive oxide P_2O_5. C-V curves with negligible hysteresis and with very good MIS behaviour were obtained for passivated sample, which indicate low density of fast traps near the conduction band edge. C-V measurements for different sweep rates at higher biases show no drift in hysteresis and this indicates the highly stable nature of CdS passivated InP interface even at higher bias values**.** To analyse the stability of the oxides further, bias stress measurements were also carried out on the samples. The surface state density (N_{SS}) values for the unpassivated sample have been calculated using Terman analysis as 6×10^{10} cm^{-2} eV^{-1} at the midgap and 4×10^{11} cm^{-2} eV^{-1} at the conduction band edge. This shows the presence of high density of fast traps and the non-uniform interface trap distribution. The N_{SS} values calculated for the passivated sample are 10^{10} cm^{-2} eV^{-1} throughout the entire band gap which establish the presence of low density of traps and uniform interface trap distribution. Up to our knowledge, this is the best-reported N_{SS} value for InP.

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INVESTIGATIONS OF SEMICONDUCTOR DETECTOR CHARACTERISTICS IN n , γ IRRADIATION CONDITIONS

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This paper presents effects of the radiation were studied using a novel, non-invasive method for analyzing its influence on the ideality factor of the I-V characteristics of photodetectors and nuclear semiconductor detectors. Basic effect produced by neutrons and gamma rays is so called displacement damage (displacement of atoms and creations of vacancies and interstitial). Interaction of photons with semiconductor materials leads to ionization and generation of electron-hole pairs. In Si photodetectors this could lead to quasi-permanent and permanent effects. The main effects of irradiation on photodiodes is an increase in the dark current. Generation of electron-hole pairs and displacement damage result in noise increase. Since presence of noise cold be connected with the excess current, measurement of the dark I-V characteristics before and after irradiation reveals the extent of electrical properties degradation of semiconductor devices. In this paper, influence of irradiation effects on ideality factor of photodiodes was studied, using the fact that this parameter could be easily extracted from I-V curves. Since ideality factor directly indicates dependence of output characteristics of photodiodes on electrical transport properties of the junction, it could be used for evaluation of possible degradation of photodiodes caused by irradiation. This presents a novel, simple and non-invasive method for performance monitoring of photodiodes and detectors in radiation environment.

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ANALYSIS OF MORPHOLOGY CHANGES OF HEAT TREATED METALLISATIONS OF COMPOUND SEMICONDUCTORS BY FRACTALMATHEMATICAL METHODS BASED ON THE FAST WAVELET-TRANSFORM

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The heat treatment of the metallised compound semiconductors results material diffusion. This technique can be used to make Ohmic-contacts. The morphology changes of the surface can be detected by scanning electron microscope. These patterns show fractal character. This paper is about a simple method to analyze the electron microscopic images by fast wavelet-transform based on the pyramid function. Our team has found a correlation of the fractal dimensions and the appearance of the Ohmic-contact.

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ELECTRIC BIREFRINGENCE AND LIGHT SCATTERING STUDIES ON SODIUM ALGINATE SOLUTIONS IN PRESENCE OF CALCIUM IONS

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The gel properties of calcium alginate gels obtained from sodium alginate in calcium ion rich solutions are mainly governing by concentration of calcium ions, pH, temperature and molecular properties of sodium alginate macromolecules. Any presence of divalent actions (Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}) in the pregel stage of alginate gel preparation have a strong influence on alginate gel properties after ending the gel stage of preparation. The presence of large domains of unhomogenity in the gels, profile distribution of homogenity through a core-shell section and the presence of gel-in-the-gel of calcium alginate are examples for such properties. Working with electric birefringence and light scattering we investigated molecular properties of sodium alginate solutions in presence of small amounts of calcium ions. The number, size and shape of alginate microgel domains in solutions have been determined for alginates with three different molecular weights and M/G ratios at several temperatures. In further, we'll work on connections of pregel properties of sodium alginate solutions with the postgel properties of calcium alginates.

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STATISTICAL PROPERTIES OF AUGER AMPLITUDES AND SELECTION RULES FOR THEIR MAXIMUM VALUES

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The Auger transition is the main deexcitation way of an atom with a vacancy except the inner shells of heavy atoms. Statistical properties of the Auger spectra have been investigated for the first time. The fairly accurate formula for the number of Auger amplitudes is derived. The symmetry property for this number is determined. It is shown, that the statistical properties of the Auger amplitudes mainly depend on the orbital quantum numbers of the shells involved in the transitions. For some characteristics the clearly expressed dependence on the even and the odd numbers of the electrons in the outer open shell having integer or half – integer values of spins takes place. The calculations have been performed for the transitions of a type $p^5 d^N \to p^6 d^{N-2} \varepsilon l$, $sd^N \to s^2 d^{N-2} \varepsilon l$ and $d^9 p^N \to d^{10} p^{N-2} \varepsilon l$. Rather large values of skewness and excess indicate a significant deviation of the distribution of the Auger amplitudes from the normal distribution [1]. The maximum values of the Auger amplitudes, corresponding to the transitions between two configurations obey rather strict selection rules as they are formulated for the jj and LS coupling schemes.

1. A.Kynienė, R.Karazija, V.Jonauskas. J.Electron. Spectrosc. Relat. Phenom. 122, 181 (2002)

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