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DEPARTMENT OF PHYSICS

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RESEARCH GROUP IN *APPLIED PHYSICS*

Researches in *MAGNETIC AND MAGNETOELASTIC PROPERTIES OF AMORPHOUS, NANOCRYSTALLINE AND CRYSTALLINE MATERIALS*

Keywords: amorphous and nanocristalline alloys, structural relaxation, crystallization, Mössbauer effect.

FIELD DESCRIPTION

Correlation of physical properties with amorphous CSRO and TSRO, nanocrystalline structures and investigation of kinetic processes activated by annealing was made. Magnetic and magnetoelastic properties of amorphous and nanocrystalline alloys were examined.

ACTIVITIES

Investigations of structural relaxation in FeCrPMnC ribbons and crystallization of FeCrP and FeGdB ribbons were made. Correlation of magnetic properties with structural information (by XRD, DSC, Mössbauer effect) and magnetoelastic properties were examined.

RESEARCH PROJECTS

CNCSIS Research Grant A137 No.32940 / 22.06.2004, phase 2005, *Nanocrystalline alloys of type rare earth transition metals with the very high magnetostrictiv*, 72.000 RON

PUBLISHED PAPERS

1. Mihalca, I., Kuncser, V., Valeanu, M., Ercuţa, A., Hărăguş, Şt., Damian, I., *Correlation of Structural and Magnetostrictive Properties of Amorphous RE-TM-B Alloys*, Proceedings of the IEEE Magnetic Society, Chapter Romania Section, Iaşi, 22-26 October 2005, pp. 6, http://stoner.phys.uaic.ro/ROMSC2005
2. Mihalca, I., Kuncser, V., Valeanu, M. Ercuţa, A., Damian, I. , Sofronie, M., Schinteie, G., Tolea, F., *Structural and Magnetoelastic Properties of Amorphous Fe-Co-Sm-B Alloys*, Proceedings of the 14th National Conference on Physics, Bucharest, 13-17 Sept. 2005, Abstracts, vol.1, ISBN 973-718-304-5, pp. 63, http://cnf2005.nipne.ro/ProgramCNF.doc
3. Crăciunescu, C.M., Mihalca, I., Budău, V., *Trimorph actuation based on shape memory alloy*, Journal of Optoelectronics and Advanced Materials, 7, nr. 2, 2005, pp.315-320

PERSPECTIVES

The increasing scientific and technical interest in highly performant materials led to researches in view to elaborate new RE-TM-M (RE=Nd, Sm, Gd,…; TM=Fe, Ni, Co, Mo,…; M=B, P, C, Si) alloys. Both magnetic (Ms, Hc, Tc,...) and magnetoelastic properties of these materials are interesting for fabrication of different type of sensors and actuators.

RESEARCH TEAM

- Prof.dr. Ioan MIHALCA
- Prof.dr.eng. Ştefan HĂRĂGUŞ
- Assoc.prof.dr. Aurel ERCUŢA
- Lecturer dr. Ioan DAMIAN
- Assist.dr. Simona PRETORIAN

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Researches in *STUDIES AND INVESTIGATIONS IN SOLAR ENERGY*

Keywords: flat plat collector, stockage, heat exchanger, energy efficiency, and specific power of solar collector, energy flow rate, and specific entropy.

FIELD DESCRIPTION

A considerable part of low-potential heat requirement may be covered by solar energy in domestic and industrial area at our latitude (45 ^{0}N). It is possible that solar gain of such system attains an average of 70 kg·m^{-2}·year^{-1} of conventional fuel.

ACTIVITIES

The studies in this field have been made, at the Technical University of Timişoara, since 1976. Here has been materialized a multifunctional laboratory in order to study the new types of solar collectors and a complete system containing following segments: flat plat collectors, heat

exchangers and storage heating systems. Some industrial utilization have been designed and constructed on these studies.

RESULTS

BOOKS

Luminosu, I., *Physics – Aplications, tests*, Politehnica Publishing House, ISBN 973-625-159-4 (in Romanian), 222 pages

PUBLISHED PAPERS

1. Fara, L., Luminosu, I., *Experimental Studies Concerning Active and Passive System Developments in Romania*, 14th National Conference of Physics, Bucharest, September 2005, http://cnf2005.nipne.ro/ProgramCNF.doc
2. Luminosu, I., Fara, L., *Thermodynamic Analysis of an Air Solar Collector*, International Journal of Energy, Elsevier, vol. 2, No. 4, 2005, pp. 385-408
3. Luminosu, I., Fara, L., *Determination of the Optimal Operation Mode of a Flat Solar Collector by Energetic Analysis and Numerical Simulation*, International. Journal of Energy, Elsevier, 30, 5, 2005, pp. 731 –747
4. But, A., Luminosu, I., *The Veining Structure Method, the Finite Element Method in Thermal Deformation Determination for the Main Spindle at Numerical Control Lathes*, Thermal Science - An International Journal, VINČA Institute of Nuclear Sciences (Yu), 9, 1, 2005, pp. 99 – 110

PERSPECTIVES

The energy analysis could be developed for a more complex model that would include the solar collector and the accumulator, and searching the optimal values in a four-dimension space, namely: energy efficiency, flow rate, collector area, and heat accumulator volume.

RESEARCH TEAM

- Lecturer dr. Ioan LUMINOSU
- Prof.dr. Laurentiu FARA, "Politehnica" University of Bucharest
- Dr. Adrian BUT, Devices & Tools Department, "Politehnica" University of Timisoara

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Researches in *STRUCTURE, ELECTRIC AND MAGNETIC PROPERTIES OF SOME METALS SYSTEMS AND METALLIC OXIDIC SYSTEMS*

Keywords: absorbtion, reflection, oxides, dielectric, hysteresis

FIELD DESCRIPTION

The preparation of new dielectric and magnetic materials by coprecipitation and by melting of oxides; The experimental study of structure of materials by X-ray diffraction, IR absorption spectra, reflection spectra; Complex magnetic susceptibility study with Q-meter; The hysteresis loops in dynamic and static regime.

ACTIVITIES

Documentation in the research field;
The establishment of samples preparation optimal conditions and the preparation of some samples;
The structure of some samples was studied by many physical methods and these results will be the subject of some papers in the next months.

PUBLISHED PAPERS

Cristea, M., *IR Absorption of Some Me_2O_3 Oxides and their Solid Solutions*, Scientific Bulletin of the "Politehnica" University of Timisoara, Transactions on Mathematics and Physics, Tom 50(64), fasc. 2, 2005, pp. 30-38

PERSPECTIVES

The X-Ray structural data interpretation for the obtained samples and for the new samples;
The magnetic and electric properties study of these samples; The participation as member in the proposed research project in 2006, in the collaboration with Chemistry Section Timişoara of Science Academy, in case of the approval of our proposal.

RESEARCH TEAM

- Prof.dr. Minerva CRISTEA
- Prof. dr. Alicja RATUSZNA, Institute of Physics Katowice – Poland
- Prof. dr. Johanna KAPUSTA, Institute of Physics Katowice – Poland
- Lecturer dr. Ioan LUMINOSU
- Lecturer dr. Paul BARVINSCHI, University of West, Timisoara
- Lecturer dr. Nicoleta ŞTEFU, University of West, Timisoara
- Assoc.prof.dr. Gostic CAIZER, University of West, Timisoara

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Researches in *NON – DESTRUCTIVE TESTING (NDT) METHODOLOGY AND TECHNOLOGY*

Keywords: X-rays, gamma rays, non destructive technology, steel

FIELD DESCRIPTION

The Coordinated Research Project (CRP) on Validation of Protocols for Corrosion and Deposit Evaluation in Large Diameter Pipes by

Radiography, under the auspices of the International Atomic Energy Agency, started in 2002.
Radiography is one of the NDT methods which permits an inside view of the material under test. The electromagnetic waves coming from X rays tube, or gamma rays from radioactive sources – Co^{60}, Ir^{192} – are directed on the pipeline of large diameters – 6 inches to 20 inches – and recorded by photo sensitive films. The films are chemically processed and a radiograph is thus obtained. Measuring the film density one can determine the dimensions of the defect done by corrosion or deposits.

ACTIVITIES

Measurements using X rays and Ir - gamma rays have been done in order to get information regarding the dimensions of the defects of large diameter pipelines. Using the Double Wall exposure I have found a formula – for the first time in literature – of the absorption coefficient of X rays in steel, and, also, another formula for absorption of the Ir^{192} - gamma rays in steel. Measurements using Tangential Technique were also done, in order to evaluate the defect's dimensions.
The scope of the research was to define a limit of detection for each radiation source and, finally, to propose a protocol as an international standard – e.g. ISO – with full implementation of recognized quality assurance methodologies.

RESEARCH PROJECTS

Contract No. 12111/R2, *Walls' thickness measurements using radiographic X rays and gamma rays method, for pipelines having diameters larger than 150 mm*, Director: Dr. V. Dorobantu, Value: 2.000 USD, Beneficiary International Atomic Energy Agency.

RESULTS

BOOKS

1. Dorobantu, V., *Quantum Computability*, Vol. 1 – *Quantum Mechanics*, Politehnica Publishing House, Timisoara, 2005, ISBN 973-625-279-5, 973-625-280-9, 109 pages
2. Drai, R., Zirnhelt, J.H., Zscherpel, U., Balasko, M., Vaidya, P.R., Rastkhah, N., Hamzah, Ab.R., Khan, A.A., Dorobantu, V., Harara, W., Ekinci, S., Infazon, S., Ewert, U., Einav I., *Validation of Protocols for Corrosion and Deposit Evaluation in Large Diameter Pipes by Radiography*, Edited by Inernational Atomic Energy Agency, 2005, IAEA – TECDOC, 160 pages

PUBLISHED PAPERS

Dorobantu, V., Double Wall Technique pipelines' Inspection Using Gamma Rays, 2005, Vol.10, No.3,NDT.net, http://www.ndt.net/article/v10n03/dorobant/dorobant.htm

PERSPECTIVES

Researches for transition from industrial films to digital detectors to be used in Digital Industrial Radiography (DIR). Electronic detectors of X rays or gamma rays in investigating pipelines defects' have been available for many years, but with a low resolution. In the past few years a new generation of detectors have emerged yielding performance comparable to film. This transition to digital detectors requires a thorough investigation of the technical performance of the detectors compared with film, as well as, proposing correct use of the digital detectors.

RESEARCH TEAM

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Researches in *HEAT, MASS AND MOMENTUM TRANSFER PROCESSES, SOLIDIFICATION OF THE MATERIALS*

Keywords: crystals, numerical models, solidification

FIELD DESCRIPTION

The solidification of the crystals (nano-crystals) and of the polycrystals (multicrystalline Silicon) takes place within various heat, mass and momentum fields. The numerical models of the transfer processes is a very active domain of the research and can provide a deep knowledge of the phenomena associated with the solidification matter. The numerical soft Fluent™ is commercial software, and I am using it for numerical modelling of the heat, mass and momentum fields in various solidification furnaces.

RESEARCH PROJECTS

1. Code project 4257, No. contract 410, type project PED; MENER, Bucuresti, Researches regarding the combined burn of the urban wastes or of the biomass with carbon and the depuration of the burned gases, Director: Prof. dr. eng. Ioana Ionel; 150.000 RON, collaborator: Assoc.prof.dr. Floricica Barvinschi
2. No. CEX05-D11-63/10-10-2005, type CEEX; University of Bucharest; *Optical and electronically phenomena in organic materials with conjugate connections for photonics applications*, Director: Prof.dr. Stefan Antohe, University of Bucharest, 14.000.000 RON, responsible partner P4: Assoc.prof.dr. Floricica Barvinschi

PUBLISHED PAPERS

Nyari, T., Barvinschi, P., Băieş, R., Vlăzan, P., Barvinschi, F., Dékány, I., *Experimental and Numerical Results in Hydrothermal Synthesis of $CuInS_2$ Compound Semiconductor Nano-crystals*, ICCG 14-ICVGE12, Grenoble, France, 2004, Proceedings of the ICCG14-ICVGE12, Journal of Crystal Growth, 2005, Vol.275 Issues 1-2 pp. e2383 - e2387, http://iccg14.inpg.fr

PERSPECTIVES

In the future the numerical simulation of heat, mass and momentum transport phenomena should have a very good development and a lot of application in the casting, solidification and crystal growth matter. A good knowledge of the industrial furnaces it is not possible if only experimental way is used. The modelling of the real equipments will be a very appropriate tool for providing design and optimisation.

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RESEARCH GROUP IN *THEORETICAL PHYSICS*

Researches in *QUANTUM INFORMATION AND THE COHERENT STATES FORMALISM*

Keywords: quantum information, qubit, density matrix, coherent states, harmonic oscillator.

FIELD DESCRIPTION

The quantum mechanics and the theory of information are two very prolific scientific fields founded in XX century. The synergetic result of their interaction is the theory of quantum information. In our researches we examine the connection between the information and the quantum states, particularly the coherent states. In this way, the coherent states formalism becomes an useful instrument to characterize the quantum information. On the other hand, a quantum system is connected by the corresponding density matrix. Their trace is the quantum partition function, which contains maximal information about the properties of the systems.

ACTIVITIES

Since 1978, theoretical investigation were made on the description of the multielectronical systems (particularly, diatomic molecules) by means of the density matrix approach. This approach were applied, also, to the harmonic or anharmonic oscillators, especially the pseudoharmonical and Morse oscillators. Some results were used for the elaboration of the doctoral thesis and other scientific works in the physics journals.

RESEARCH CONTRACTS

CNCSIS Research Grant A 647 No. 27688 / 14.03.2005, *Contributions to the employment of the coherent states in the physics of quantum information*, Value 6.630 RON for 2005, Director: Assoc.prof.dr. Duşan Popov

BOOKS

Tosic, B., Sajfert, V., Popov, D., Setrajcic, J., Ciric, D., *Applications of the finite difference calculus in the nanostructures analysis*, Publishing House of the Voivodina Academy of Sciences and Arts, Serbia and Montenegro, Novi Sad, 2005, ISBN 86-85889-00-6, 193 pages (published in Serbian)

PUBLISHED PAPERS

1. Sajfert, V., Setrajcic, J., Popov, D., Tosic, B., *Difference equations in condensed matter physics and their applications in thin molecular films*, Physica A: Mechanics and its Applications, Vol. 353, 2005, pp. 217 – 234
2. Zaharie, I., Popov, D., *Nonlinear coherent states for pseudoharmonic oscillator*, Romanian Journal of Optoelectronics, Vol. 13, No.1, 2005, ISSN 1453-0600, pp. 59-70
3. Putz, M. V., *The Quark Atom: Electronegativity*, Annals of the University of West in Timisoara, Series Chemistry, Vol. 14, No. 1, 2005, pp. 47-66
4. Putz, M. V., *Markovian Approach of the Electron Locilization Functions*, International Journal of Quantum Chemistry, Vol. 105, 2005, pp. 1-11
5. Popov, D., Zaharie, I., *Examination of the pseudoharmonic oscillator by means of the Gazeau-Klauder coherent states*, Proceedings of the 14th National Conference on Physics, Bucarest, 13-15 Sept. 2005, Abstracts, Vol. 1, ISBN 973-718-304-5, pp. 126, http://cnf2005.nipne.ro/ProgramCNF.ro
6. Străuți-Negru, G., Gruescu, C., Costache, M., *Uncertainty in optical products choice*, International Symposium of Management SIM – 2005, CD –ROM edition, 8 pages

PERSPECTIVES

The results of the present investigations will be used to continue the CNCSIS Research Grant entitled *"Contributions to the employment of the coherent states formalism in the physics of quantum information"* and to publish some scientific papers in this field and also to edit a book about the quantum information in the multiparticle physical systems.

RESEARCH TEAM

- Assoc.prof.dr. Duşan POPOV
- Lecturer dr. Ioan ZAHARIE
- Lecturer dr. Mihai Viorel PUTZ
- Assist. Marius COSTACHE
- Eng. Deian POPOV

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Researches in *RELATIVISTIC TELEMETRY AND COSMOLOGICAL MODELS*

Keywords: special relativity, generalized relativity, radar detection, Doppler shift, classical and quantum fields, gauge theories

FIELD DESCRIPTION

The research work started in 1990 being concerned with the detection of fast moving objects, taking into account the relativistic effects.

Researches are aimed to the introduction of higher derivatives in modern, classical and quantum field theories.

ACTIVITIES

During the year 1994 we have studied the following problems: the possibility to use television techniques in order to detect relativistic effects; the possibility to avoid clock synchronization, by using the radar detection or the photographic detection; the behaviour of light source, mirrors incident and reflected rays moving at relativistic speeds.

Researches begin several years ago and more papers have been published on the topic (in Physical Review, Physical Letters, Nuovo Cimento and international conference papers).

BOOKS

Pretorian**,** S., *General physics elements throught solved and proposed problems*, Politehnica Publishing House, Timişoara, 2005, ISBN 973-625-250-7, 61 pages

PUBLISHED PAPERS

1. Rothenstein, B., Damian, I., *Watching a uniformly moving source of light using a telescope and a frequency-meter*, ArXiv online, 5 pages , http://arxiv.org/abs/physics/0504027
2. Rothenstein, B., Damian, I., *Length measurement of a moving rod by a single observer without assumptions concerning its magnitude*, ArXiv online, 5 pages http://arxiv.org/abs/physics/0507016
3. Rothenstein, B., Damian, I., *Special Relativity in the Electromagnetic Wave*, ArXiv online, 7 pages, http://arxiv.org/abs/physics/0504199
4. Rothenstein, B., Damian, I., *Photographing a time interval*, ArXiv online, 7 pages http://arxiv.org/abs/physics/0507097
5. Rothenstein, B., Damian, I., *Aberration associated with the reflection of light on a moving mirror*, ArXiv online, 5 pages http://arxiv.org/abs/physics/0508084
6. Rothenstein, B., Popescu, Şt., Spix, G.J., *Special relativity without distant clock synchronization*, ArXiv online, 7 pages http://arxiv.org/abs/physics/0512032
7. Rothenstein, B., Popescu, Şt., Spix, G.J., *Illustrating the relativity of simultaneity*, ArXiv online, 9 pages http://arxiv.org/abs/physics/0511062
8. Rothenstein, B., Băuneşcu, D., *Polar coordinates, special relativity and CAS*, ArXiv online, 3 pages, http://arxiv.org/abs/physics/0511051
9. Rothenstein, B., Popescu, Şt., Spix, G.J., *Illustrating the Michelson-Morley experiment*, ArXiv online, 13 pages, http://arxiv.org/abs/physics/0510178
10. Babeţi, S., *Dilaton-dependent α' corrections in gauge theory of gravitation*, Romanian Journal of Physics, vol.50, No. 3-4, 2005, pp. 231-241
11. Babeţi, S., Zet, G., *An algebraic computing program for studying cosmological models without singularities*, Proccedings of the 3rd International Colloquium "Mathematics in Engineering and Numerical Physics" (MENP-3), October 7-9, 2004, Bucharest, Balkan Society of Geometers, Geometry Balkan Press, 2005, pp.1-11, http://www.mathem.pub.ro/dept/colloq04/COLLOQ4.HTM
12. Babeţi, S., Chirițoiu, V., Zet, G., *Methods and models with nonsingular solutions in a gauge theory of gravitation*, Int. Conf. Fundamental and Applied Research in Physics, 27-29 October 2005, Iaşi, Romania, Abstracts, pp. 104,http://home.uaic.ro/~farphys/homepage.htm
13. Babeţi, S., Zet, G., *A Gödel type solution in a gauge theory of gravitation*, Physics Conference Tim-05, November 25-26, 2005, Timişoara, Abstract Book, pp.39, http://www.ri.uvt.ro/events_ro.htm

RESEARCH TEAM

- Prof.dr. Bernhard ROTHENSTEIN
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- Assist. Viorel CHIRIȚOIU

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Researches in *OPTIMIZATION OF PARTICLE CLUSTERS*

Keywords: particle clusters, molecular structure, optimization methods

FIELD DESCRIPTION

Optimization of particle clusters deals with identifying stable molecular or atomic structures by minimizing the corresponding energy functions. In the last decade there have been analyzed models defined by different potentials (Lennard-Jones, Morse, Dzugutov etc) and different optimization methods have been proposed. However a lot of problems, particularly related with the drawbacks of the current methods, are still open.

ACTIVITIES

Related with the optimization of particle clusters I proposed a hybrid global optimization method based on an evolutionary algorithm and a local minimization scheme. The proposed method has been tested for optimization of clusters described by different types of potential: Lennard-Jones, Morse and Dzugutov.

BOOKS

Zaharie, I., *Laboratory tutorial* - 10 works, 80 pages, http://fizica.upt.ro/ioan_zaharie

PUBLISHED PAPERS

Zaharie, I., Zaharie, Daniela, *Evolution Optimization of Molecular Clusters*, Studia Universitatis Babes-Bolyai Physica, L4a, 2005, pp. 447-450

PERSPECTIVES

With respect to the optimization of particle clusters a more detailed analysis of the scalability of the proposed method is planned. On the other hand the research will be oriented towards identifying adequate potentials for particular types of clusters.

RESEARCH TEAM

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