

SUMMARY OF THE INTERNATIONAL CONFERENCE ON MATERIALS SCIENCE AND CONDENSED MATTER PHYSICS

The present journal issue starts the publication of the proceedings of the 3rd International Conference on Materials Science and Condensed Matter Physics, which took place at Chisinau, Republic of Moldova, between 3-6 October 2006. This conference was the third one of the series, following the first one in 2001 [1] and the second one in 2004 [2]. MSCMP 2006 was dedicated to the 85th and 80th anniversaries of outstanding Moldavian physicists Tadeusz Malinowski and Sergey Radautsan in the year of 60th jubilee of the Academy of Sciences of Moldova. As for the earlier editions of the conference, the main objective of MSCMP 2006 was to bring together scientists from different areas of Condensed Matter Physics and Materials Science. Motivation for the conference comes from:

- Quickly changes in the MS and CMP investigations and appearing of new areas of researches.
- High level of investigations on MS and CMP in Moldova Research Centers.
- Successful organization of the first editions of MSCMP in 2001 and 2004.

MSCMP 2006 program has included invited and contributed (oral and poster presentations) papers covering the following domains:

- **Materials and solid-state structure processing** including the aspects of advanced materials and fabrication processes; methods of crystal growth, post-growth technological processes, doped media, ion implantation, fabrication of solid state structures; defect engineering, engineering of molecular assembly.
- **Characterization** including the aspects of: methods of material and structure characterization; micro-analysis, microscopy and spectroscopy; structure and mechanical characterization; optical, luminescence and photoelectrical properties; electrical, magnetic and superconductor properties, non-linear phenomena.
- **Condensed matter theory** highlighting the topics: advances in condensed matter theory; theory of low dimensional systems; modelling of materials and structure properties; development of theoretical methods of solid-state characterization; phase transition; advanced quantum physics for nanosystems.
- **Nanotechnology, nanostructures and nanoelectronics** considering the areas: methods of nanostructure fabrication and characterization; quantum wells and superlattices; nanocomposite, nanowires and nanodots; fullerenes and nanotubes, molecular materials, meso- and nanoelectronics.
- **Solid-state device physics** covering the topics of device modelling and simulation, device structures and elements; semiconductor micro- and optoelectronics; photodevices and photonics; microsensors and micro electro-mechanical systems; signal processing and microsystems; degradation and reliability, advanced solid-state devices.
- **Structure of organic and inorganic materials.**

All these conference topics are in the flow of Strategic Scientific Themes in the Modern Condensed-Matter and Materials Physics [3].

- **The structure and properties of materials at reduced dimensionality.**
- **Materials with increasing complexity in composition, structure and function.**
- **Nonequilibrium processes and the relationship between molecular and mesoscopic properties.**

- **Soft condensed matter and the physics of large molecules, including biological structures.**
- **Controlling electrons and photons in solids on the atomic scale.**
- **Understanding of magnetism and superconductivity.**
- **Properties of materials under extreme conditions.**
- **Material synthesis, processing and nanofabrication.**
- **Moving from empiricism toward predictability in the simulation of material properties and processes.**
- **The quantum mechanics of large, interacting systems.**

Discussing some aspects of Novel Quantum Phenomena the participants of MSCMP 2006 trying to get new answers for following general questions:

- Can quantum energy scales be boosted so that, for example, room-temperature mesoscopic and single electron devices can be constructed?
- Can we develop practical theoretical tools to describe real-time dynamics and nonlinear response of interacting quantum systems as well as their electronic structure?
- Can we develop general principles to guide us in the study of modern materials that are vastly more complex than materials of the past?
- What is the physics of the normal and condensed states of high-temperature superconductors? Can we synthesize room-temperature superconductors and overcome practical material difficulties?

The presentations dealing with the topics of New Materials and Structures have been focused on the questions:

- Can we complement empiricism with predictability in our search for new materials and structures with desired properties? Can we predict the composition and structure of a new material, its properties and how to synthesize it?
- Can we develop a full understanding of the initial stages of growth?
- Can we develop a full understanding of the relationship between the detailed structure of a material and its properties? Can we truly control defects?

Considering the Condensed Matter Physics and Materials Science as the basis of Modern Technology the papers dedicated to some of the application aspects reveal some suggestions concerning the following major questions:

- What technology will replace normal metals and dielectrics for interconnect as speed continues to increase?
- What is beyond today's FET-based silicon technology?
- Can we create an all-optical communications/computing network?
- Can we understand magnetism on the meso/nano scales needed to continue to advance technology?
- Can we fabricate devices with 100 percent spin-polarized current injection?

The core of the MSCMP 2006 was a set of general invited lectures followed by more specific presentations on current issues in the main areas of the field. The sections were, in sequence, devoted to the following:

- Characterization of materials and structures
- Condensed matter theory

- Materials and solid-state structure processing
- Nanotechnology, Nanostructures and Nanoelectronics
- Solid State Device Physics.

250 papers have been presented at the conference:

- Invited: 26
- Oral: 68
- Poster: 156

The distribution of the presentations among the sections were:

“Materials and solid-state structure processing” — **40 papers** (12 oral and 28 poster presentations).

“Materials and structure characterization” — **96 papers** (20 oral and 76 poster communications).

“Condensed matter theory” — **27 papers** (9 oral and 18 poster communications).

“Nanotechnology, nanostructures and nanoelectronics” - **38 papers** (22 oral and 16 poster communications).

“Solid-state device physics” — **23 papers** (5 oral and 18 poster communications).

The conference attracted around 160 participants from 16 countries (**France, United Kingdom, Israel, Greece, USA, Poland, Hungary, Turkey, Spain, Romania, Latvia, Russia, Belorussia, Ukraine, Moldova**).

We thank the session chairmen and all speakers for the high quality of their contributions. The structure of this issue of the proceedings follows the sequence of the oral presentations in the Conference, complemented by some papers selected from the poster sessions.

Two round-table discussion sessions were organized to discuss issues that have important impact on physics role in science education and society development: “Physics and Science Education” and “Physics and Society”. Round table discussions have put in evidence a lot of questions dealing with development of MS and CMP investigations, sharing the experience of different countries in developing links between physics and society, integration of investigations in the developed countries and Eastern Europe countries.

Round table on “Physics and Society” considers as priorities:

- better understanding of the economics needs,
- finding of new forms of interaction of MSCMP and economy,
- development of new form of collaboration between the developed countries and Eastern Europe countries.

On the basis of presented papers and taking into account the evolution in the MS and CMP the participants of the Conference consider the following priorities of MSCMP investigations for the near future:

- Develop advanced synthesis and processing techniques, including those for nanostructures and self-assembled one-, two- and three-dimensional structures;
- Pursue the physics and chemistry of new materials for optical, electrical and magnetic applications;
- Develop new tools to synthesize, visualize, characterize and manipulate new materials and structures;
- Merge molecular chemistry and condensed-matter and material physics to understand and control fabrication and processing on multiple lengthscales;

- Integrate processing of new materials and structures with existing technologies;
- Metamaterials, new carbonic forms, nanostructured materials, ternary and multinary compounds are likely to present a great opportunity for study of novel electronic, photonic and other phenomena and properties;
- There are challenging problems of condensed matter theory that involve mechanisms of superconductivity and magnetism, nonlinear optical processes, etc.;
- Recent developments in scientific instrumentation, especially atomic scale resolution in probe microscopy, plus extraordinary advances in computing power, mean that long-standing problems in solid mechanics should now be solvable;
- Exploit physics and material science for low-cost manufacturing.

References

- [1] Abstracts of the 1st Int. Conf. on Materials Science and Condensed Matter Physics, July 5-7, Chisinau, 2001.
- [2] Abstracts of the 2nd Int. Conf. on Materials Science and Condensed Matter Physics, September. 21-26, Chisinau, 2004.
- [3] <http://books.nap.edu/catalog/6407.html>

Finally, on behalf of the MSCMP 2006 Program and Organizing Committees, we wish to deeply thank all the people who generously helped us in organizing and running the MSCMP 2006 conference.

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Chairman of the Program Committee

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Chairman of the Organizing Committee