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Plenary Session of the Division IV

The Plenary Session of the Division IV — Technical Sciences of the Polish Academy of Sciences was held on March 25th, 2004.

During the Session two scientific papers were presented:

Professor Roman Pampuch

New Materials and Technologies

Materials are conventionally divided in structural and functional ones. A development in the first group of materials has been characterised by an increase of phasal complexity — from single-phase materials through surface-modified to fibre re-inforced composites, laminates and functional gradient materials and, often, by a decrease of dimensions of the constituent grains and particles down to nanometers. Along with similar trends in the field of functional materials, the requirements of information & telecommunication technologies, of biotechnology etc. have resulted here in a miniaturisation and integration of components. These trends are well illustrated by biomimetic materials, 1D nanomaterials, active smart systems, photonic crystals and materials for microfluidics.

New functional materials require new methods of micro- and nanofabrication. Most methods described in the paper, like lithography, size diminution of glass tube -diameter, application of ceramic green tapes, crystal growth from the gas phase provide examples of the "top-down" approach, i.e. of an adaptation of earlier fabrication methods for producing larger components. It is most probable that in the future they will be backed by fabrication methods based on the "bottom-up" approach, utilising the principle of self-replication. Soft lithography is quoted as an example of steps in this direction.

Professor Antoni Rogalski

Progress in Infrared Detector Technology

Progress in infrared (IR) detector technologies during two hundred history of their development is presented. Classification of two types of infrared detectors (photon detectors and thermal detectors) is done on the basis of their principle of operation. The overview of infrared systems and detectors is presented. Also recent progress in different IR technologies is described. Discussion is focused mainly on current and the most rapidly developing detectors: HgCdTe heterostructure photodiodes, quantum well AlGaAs/GaAs photoresistors, and thermal detectors.

All quantum well photodetectors are based on "bandgap engineering" of layered structures of wide bandgap (relative to thermal IR energies) materials. The structure is designed in such a way that the energy separation between two of the states in the structure match the energy of the infrared photons to be detected.

Up till the nineties of last century, thermal detectors were considerably less exploited in commercial and military systems in comparison with photon detectors. The reason for this disparity is that thermal detectors are commonly believed to be rather slow and insensitive in comparison with photon detectors. In the last decade, however, it was shown that extremely good imagery can be obtained from large thermal detector arrays operating uncooled at TV frame rates.

Progress in infrared detector technology is especially presented for HgCdTe devices. Historically, crystal growth of HgCdTe has been a major problem mainly because a relatively high Hg pressure is present during growth, which makes it difficult to control the stoichiometry and composition of the grown material. The epitaxial techniques offer, in comparison with bulk growth techniques, the possibility of growing large area epilayers and sophisticated device structures with good lateral homogeneity, abrupt and complex composition and doping profiles, which can be configured to improve the performance of photodetectors. LPE growth of thin layers on CdTe substrates began in the early-to-mid 70's last century. In the early 90's, bulk growth was replaced by LPE and is now very mature for production of first- and second-generation detectors. The era of MBE and MOCVD began in the early 80's by adopting both methods well established in the III-V semiconductor materials.

Finally, the outlook for near-future trends in IR technologies is presented.

Moreover, the newly elected corresponding member of the Polish Academy of Sciences professor Jacek Błażewicz briefly presented his scientific achievements. The rest time of the session was devoted to the actual organizing problems of the Division IV.

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Actualities

The 21st International Congress Theoretical and Applied Mechanics (ICTAM) will be held from 15 to 21 August, 2004 in Warsaw. The Congress was invited by the:

- Polish National Committee of IUTAM
- Institute of Fundamental Technological Research of the Polish Academy of Sciences
- Warsaw University of Technology

International Congress Theoretical and Applied Mechanics is the most important scientific event in mechanics and related disciplines. Every four years scientists from all over the world gather to present their research results. ICTAM 2004 will gather over 1000 participants. The congress is a unique opportunity for scientists to have an overview of the latest achievements in a broad spectrum of disciplines in which mechanics is playing an important role.

21st Congress covers 63 topics in separate sessions. Some of them, showing the broad field of theoretical and applied problems, are listed below:

Biological fluid dynamics • Combustion and flames • Complex and smart fluids • Convective phenomena • Drops and bubbles • Environmental fluid dynamics • Flow in porous media Flow in thin films • Fluid mechanics of materials processing • Fluid mechanics of suspensions • Granular flows • Magnetohydrodynamics • Solidification and crystal growth • Stirring and mixing • Turbulence • Waves.

Contact and friction mechanics • Control of structures • Damage mechanics • Fatigue • Impact and wave propagation • Mechanics of composites • Mechanics of porous materials • Mechatronics • Multibody dynamics • Rock mechanics and geomechanics • Solid mechanics in manufacturing • Stability of structures • Stochastic micromechanics • Structural optimization • Structural vibrations • Vehicle dynamics.

Acoustics • Chaos in fluid and solid mechanics • Fluid-structure interaction • Mechanics of foams and cellular materials • Multiscale phenomena in mechanics.

Moreover 6 Mini Symposia are in the program of ICTAM04. They deal with the following up to date, interdisciplinary subjects: Smart materials and structures • Tissue, cellular and molecular biomechanics • Mechanics of thin films and nanostructures • Microfluidics • Microgravity flow phenomena • Atmosphere and ocean dynamics.

All information on ICTAM 2004 is available on the Congress website: http://ictam04.ippt.gov.pl.