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Editor-in-Chief Prof. Leszek A. Dobrzański

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It was said...

Prof. Danuta Hübner from Poland
European Commissioner for Regional Policy

(...)Through the cross-border programmes we can pool resources together, in order to ensure a more efficient, and joint, management of economic, environmental or social challenges. They involve citizens in implementing cross-border projects for their region. People can easily see the concrete benefits of these projects in their region and in everyday life .(...) Today, in a global world, it is clearer more then ever that the competitiveness of Europe cannot be achieved by the Union or by individual Member States. Economic success must take into account local and regional growth potential. The new regulations provide for a strategic concentration of the new cooperation programmes on themes closely linked to the Lisbon agenda for jobs and growth in order to increase the competitiveness of the European territory: innovation and entrepreneurship, environment, improved accessibility and sustainable urban development. (...)It is essential that we share this experience and exploit it to the full in our efforts to modernise our economies. Indeed it is our duty to do so. (...) I am convinced that you have accumulated experience in the methods of cooperation, which you will be able to apply with success in the future initiatives across the border.(...) We want to make sure that bright ideas emanating from regional and urban networks find their way into the new programmes (...). Cooperation across borders between different partners at all levels has contributed to this process. Border regions are the building blocks and bridges in the process of European integration. But we cannot stop here. We have to realise the next steps of our common project. I count on you to make our future as successful as our past.(...)

From the speech on "Transform the border that divides into the border that links us" in Bragańca, Portugal on 26 March 2007

Editorial

The condition of the achievement of fast and broad development by many, especially of the European Union is knowledge-based economy in which real richness including economical effectiveness, economy competitiveness and new workplaces is connected not only with the production of material goods and also with manufacturing, transfer and use of knowledge. Knowledge-based economy is able to cause sustainable development, the creation of a greater number of permanent and innovative workplaces and characterised by greater social unity, featured with the fast development of those branches of economy which are connected with information, transformation and the development of science, branches of industry numbered among high technology and also technology and services of the information society. In economy such a source of competitive dominance of the most of companies, including those small and medium ones are knowledge consuming undertakings. To the fields deciding significantly on the development in that field and on the other hand developing, thanks to that, the application of nanotechnology ensuring conditions for the development of many fields, including among others: health protection, chemistry, power engineering, optics and protection of natural environment, belong.

The introduction of new materials and the improvement of materials properties produced so far requires the outworking and the implementation of new methods of manufacturing (synthesis) and processing responsible for high quality and production costs. The knowledge and further familiarisation with numerous phenomena especially in a nanometrical and an atomic scale and taking place in an exceptional short time of femtoseconds enable the adjustment of materials properties including also nanostructural ones to the requirements raised by their practical application. It deals also with nanostructural materials which development becomes especially dynamical ones in relation to a great interest in nanostructural systems and observed intensive development of nanotechnologies. Nanotechnology was started with the classic talk "There's plenty of room at the bottom - an invitation to enter a new field of physics" given by Prof. Richard P. Feynman, a later Nobel Prize Winner in Physics on 29th December 1959 at the annual meeting of the American Physical Society at the California Institute of Technology (Caltech). Prof. Richard P. Feynman said: "at the atomic level, we have new kinds of forces and new kinds of possibilities, new kinds of effects. The problems of manufacturing and reproduction of materials will be quite different. I am, as I said, inspired by the biological phenomena in which chemical forces are used in repetitious fashion to produce all kinds of weird effects (one of which is the author). The principles of physics, as far as I can see, do not speak against the possibility of manoeuvring things atom by atom."

It is foreseen that till 2013 the mastering of technology in a nanometrical scale can concern a huge group of products conditioning their market success. The development of nanotechnology also called molecular manufacturing or molecular nanotechnology, can be used in the nearest future for manufacturing chemical catalysers, new kinds of medicines dosed in a way not applied so far, to miniature constructions of electronic, mechanical and electromechanical devices, and also in surface engineering, ceramics and polymer technology. That is why nanotechnology has already achieved the status of national research programmes in many developed and developing countries, including among others: the USA, Japan, Canada and China, and also Bulgaria and Romania and as a result of that it is also counted as scientific and research priorities in Poland.

The basis of the creation of research programmes in that field is the development of researches of nanomaterials which deal mainly with nanometals achieved as a result of the application of huge plastic deformation, of the production of solid materials through consolidation of nanopowders and metal-matrix nanocomposites with the share of ceramic powders. Nanotechnology deals with science and engineering concerning materials manufacturing, functional structures and devices ordered in a nanometrical scale. Taking into consideration that atoms are 0.1-0.4-nm-diameter, nanostructural materials can include a few thousands of atoms. Creating nanostructural engineering materials require then precious allocation of atoms or their groups and controlling the size and makeup of created grains or blocks and includes unique technological methods. The boom of researches in the field of nanotechnology is dated from the half of the 1990s. At present particles, grains, functional structure and devices, which are of the size of 1-100 nm although sometimes that range is broadened to 200 nm, are treated as nanostructural ones. Quantum dots and wires, grains, particles, nanotubes, nanofibres, nanoboiling, nanocristales, nanoprecious self-organising and thin films, metals, intermetallic phases, semiconductors, minerals, ferroelectrics, dielectrics, composites, alloys, blendes, organic materials, organominerals, biomaterials, biomolecules, polymers, structures and functional devices are included to nanostructural materials. Space technology, aircraft, automotive industry, cutting tool, coatings, X-ray technology, catalysis, batteries, unchangeable memories, sensors, isolators, colour imagining, printers, flat panel displays, modulators, computer chips, magnetooptic discs, photodetectors, solar batteries, optoelectronics, lithography, holography, photoemiters, transistors and switches in a particle scale, transport of medicine in organism, medical implants, pharmacy, cosmetics, medicine and micro- and nanoelectromechanical MEMS/NEMS belong to the foreseen application of nanostructural materials. Structural materials have different mechanical, electrical, magnetic and optic properties than conventional ones. The application possibilities of an avant-garde and promising group of materials which application are set in various fields are developed. Nanostructural materials achieve an important meaning and technology of their production and application getting strong in industry. Nanotechology is a promising and precious way of control of environmentally friendly manufacturing by small and big structures design having complex properties. It is claimed that mircoand nanosystems are the next logical step in "the silicon revolution".

The discovery of new materials, processes and phenomena in a nanoscale and the development of new, experimental and theoretical technologies and researches create new possibilities of the development of innovative nanosystems and nanostructural materials. It is conductive to the increasing of a demand for a new multidisciplinary and system approach to manufacture micro- and nanodevices functioning unreliably. It can be achieved only by the combination of ideas of various disciplines and systematic flow of information and people among research groups and also as results of education of new specialists oriented not only in classic materials processing technologies and also or even, first of all, in the field of nanotechnologies, design, manufacturing, processing and application of nanostructural materials and systems.

The central objective of nanotechnology treated as molecular manufacturing is the design, modelling, and manufacture of systems that can inexpensively fabricate most products that can be specified in a molecular detail. Dr Ralph C. Merkle points out: "there are two more concepts commonly associated with nanotechnology: that is positional assembly (to get the right molecular parts in the right places) and massive parallelism (to keep the costs down).(...)" This would include, for example, molecular logic elements connected in complex patterns to form molecular computers, molecular robotic arms or Stewart platforms (e.g., positional devices) able to position individual atoms or clusters of atoms under programmatic control (useful if we wish to make molecular computers and other molecular manufacturing systems), and a wide range of other molecular devices. "The need for positional assembly implies an interest in molecular robotics, e.g., robotic devices that are molecular both in their size and precision. These molecular scale positional devices are likely to resemble very small versions of their everyday macroscopic counterparts.(...) We need to apply at the molecular scale the concept (...): making parts go where we want by putting them where we want ! (...)" A central concept for achieving low cost in molecular manufacturing is that of massive parallelism, either by self replicating manufacturing systems or convergent assembly. Such systems are today theoretical, but should revolutionise 21st century manufacturing. The marginal manufacturing costs for such systems should be quite small, although initial research and development costs might be quite significant. "While earlier proposals achieved massive parallelism through self replication, today's "best guess" is that future molecular manufacturing systems will use some form of convergent assembly. In this process vast numbers of small parts are assembled by vast numbers of small (...part) into larger parts (...).

The choice of priority directions of the development of science and technology also in the area of the nanotechnology with the big participation of scientists, businessmen, representatives of public administration, non-governmental and social organisations and politicians taking into consideration the possibility of the development of knowledge-based economy requires the constant verification of the foresight method being a systematical and future reaching information and enabling formulating directions and priorities of medium- and long-period developmental visions connected with current decisions and activities. Foresight sees the creation of technical and policy roadmaps as a key to accomplish a number of objectives in the nanotechnology field. For example some of the following best roadmaps related to nanotechnology were created in the first years of the 21st century: Foresight Nanotech Institute Launches Technology Roadmap for Productive Nanosystems, Foresight Nanotech Institute Roadmap Initiative, Nanotechnology for Food, Nanoscale Science and Engineering for Agriculture and Food Systems, Chemical Industry: From Fundamentals to Function, Vision 2020 Roadmap for Nanomaterials, International Technology Roadmap for Semiconductors, National Institute of Health Roadmap, Electricity Technology Roadmap Initiative, Hydrogen Roadmap, Quantum Computing Roadmap, International Micro-Nano Roadmap, Bionanotechnology Roadmap. Roadmaps help to coordinate the thinking and activity of key stakeholders including governments, corporations, research institutions, policy professionals, investors, educators and the media. They provide a framework for articulating the pathways and steps which must be taken to progress from the present state of development to a desired future goal. They illuminate what we should be focused on today and provide an important basis for defining current research and commercialisation agendas. The roadmaps aim to provide guidance regarding the challenges and opportunities for productive nanosystems and nanomaterials, describing strategic objectives for current research and their relationship to long-term goals for advanced nanotechnology. The scope of those roadmaps include among others current capabilities in design, modelling, fabrication, and testing of the nanosystems and nanomaterials, overall readiness for developing next-generation productive nanosystems and nanomaterials, strategies for developing more advanced nanosystems and nanomaterials, potential products of nanosystems and nanomaterials at successive levels of development and policy issues raised by productive nanosystems and nanomaterials. It is possible to include among others: providing renewable clean energy, supplying clean water globally, improving health and longevity, healing and preserving the environment, maximising productivity of agriculture, making information technology available to all, and enabling Space development to the foresight nanotechnology challenges. Nanotechnology can help solve all the above mentioned problems.

Surely, the nearest years and decades will bring new ideas concerning the application of nanostructural materials, nanostructures, and nanosystems in various fields of science and engineering as new technological possibilities of creating materials an atom after an atom on which researches are carried out at present very intensively and as it should be foreseen will be intensified very significantly in the future. Surely time will bring more and more results of scientific researches in the field of nanotechnology, and the next Issues of our Archives of Materials Science and Engineering wait for the publications of interesting papers in that field which rather systematically have been already appearing in this journal.

Prof. Leszek A. Dobrzanski Dr hc
Editor-in-Chief of the AMSE
President of the ACMSSE

Gliwice, in 2007

Thematic scope of papers

MATERIALS

Metallic Alloys, Tool Materials, Superplastic Materials, Ceramics and Glasses, Composites, Amorphous Materials, Nanomaterials, Biomaterials, Multifunctional Materials, Smart Materials, Engineering Polymers

PROPERTIES

Ductility, Crack Resistance, Fatigue, Creep-resistance, Fracture Mechanics, Mechanical Properties, Electrical Properties, and Magnetic Properties, Corrosion, Erosion, Wear Resistance, Non-Destructive Testing, Reliability Assessment, Toxicity, Working Properties of Materials and Products

METHODOLOGY OF RESEARCH, ANALYSIS AND MODELLING

Electron Microscopy, X-ray Phase Analysis, Metallography, Quantitative Metallography, Image Analysis, Computer Assistance in the Engineering Tasks and Scientific Research, Numerical Techniques, Statistic Methods, Residual Life Analysis, Process Systems Design, Mould Flow Analysis, Rapid Prototyping, CAM, CAMS, CAQ, Engineering Design, Technological Design, Materials Design, Computational Material Science, Materials and Engineering Databases, Expert Systems, Artificial Intelligence Methods

MATERIALS MANUFACTURING AND PROCESSING

Casting, Powder Metallurgy, Welding, Sintering, Heat Treatment, Thermo-Chemical Treatment, Thin & Thick Coatings, Surface Treatment, Machining, Plastic Forming, Quality Assessment, Automation Engineering Processes, Robotics, Mechatronics, Technological Devices and Equipment, Theoretical Fundamentals of Cleaner Production, Industrial Application of Cleaner Production Methods, Production and Operations Management, Production Planning and Control, Manufacturing Technology Management, Quality Management, Environmental Management, Safety and Health Management, Project Management, Physical Distribution and Logistics Management, Supply Chain Management, Productivity and Performance Management

EDUCATION AND RESEARCH TRENDS IN MATERIALS SCIENCE AND ENGINEERING

Development of New Curricula for BSc, MSc and PhD Studies, Challenges of the Widening Labour Market, Complementary Roles of Developed and Developing Nations in Promoting a Global Industrial and Economical Infrastructure and Requirements on Common International Research and Teaching Development, Computer Aided Teaching, E-learning

Only papers positively pre-reviewed by at least two reviewers are published in the journal.