ICAM'97/E-MRS'97 Spring Meeting Addressed Topics from Basic to Applied Research

More than 1,000 materials scientists, engineers, physicists, and chemists from 64 countries worldwide attended the International Conference on Advanced Materials and European Materials Research Society Spring Meeting (ICAM/E-MRS'97 Conference) at the Palais de Congrès, Strasbourg, France, June 16–20, 1997. Thirteen symposia with 1,230 oral and poster presentations were devoted to high-tech materials and processes. The conference program offered a range of topics from fundamental research to applied research with medium and short-term perspectives.

E-MRS addressed present-day demands in the selection of the symposia topics. The subjects included computational modeling issues in materials science, epitaxial thin film growth, characterization, surface science, III-nitrides, photonics, and biomaterials, including political questions at the interface of science, economy and policy, advanced materials education, and sustainable development in biodegradable polymers and macromolecules, environmentally-friendly energy sources, and the materials aspects of transportation.

The following descriptions of symposia are typical examples and give impressions of the ICAM'97/E-MRS'97 Conference: Symposium A on Fullerenes and Carbon-Based Materials covered recent developments in more than 100 papers. One of the highlights was the contribution of 1996 Nobel Prize recipient H.W. Kroto of the University of Sussex, Brighton, United Kingdom, with new results on polymerized C_{60}, single-wall nanotubes, and superhard and ultrahard materials, including supersmooth diamond films.

Symposium B on Epitaxial Film Growth and Nanostructures demonstrated the increasing effort of many research centers for epitaxy of thin layers and low-dimensional systems. However, not only the classical materials applied for low-dimensional systems (III-V semiconductors, Si/Si/Ge heterostructures) were studied, but epitaxial layers and nanoparticles and dots of metals and metal oxides as well, including Co/Cu, Co/Pd, Fe/Pd, Fe/Cu/Au, Pd/Cr, Au/Ni, high-temperature superconductors such as YBCO, tantalum oxide, and FeO.

New epitaxial growth methods that were presented included atomic layer epitaxy (ALE) of SiGe and III-V semiconductors, low-energy plasma deposition (LPE) of Si/SiGe, laser-assisted molecular-beam epitaxy (MBE) techniques for II-V compounds, magnetron sputter epitaxy (MSE) of Si, and ultrasound radiation methods for the preparation of nanometer-size particles. Successful methods creating nanoparticles and dots were the application of scanning tunneling microscopy (STM) metal tips, techniques of self-organized growth of nanoparticles and dots by sputtering, metalorganic chemical vapor deposition (MOCVD), and MBE. Interesting atomic scale characterization methods included high-resolution transmission electron microscopy (TEM) for microscopic diffusion phenomena, *in situ* ellipsometry for Al-CVD, surface wave propagation studies, and reflectance anisotropy spectroscopy for the characterization of low-dimensional systems. A new method for submicrometer patterning of silicide layers by local oxidation was also presented.

The largest symposium was D on Computational Modeling Issues in Materials Science, exemplifying the increasing importance attached to computational materials science. Parallel computers will play a major role in the further development of the field: Simulations with 100 million atoms approaching macroscopic dimensions have now become possible on the latest parallel hardware. Clearly, new algorithmic ideas will be needed and, in particular, scalable software will be essential for further progress. Thus, so-called order-N methods were the subject of lively debates.

Another clear trend is the emergence of the Car-Parinnello method as a work horse for the most advanced simulations, simultaneously combining electronic structure and molecular dynamics optimization. Only a few years ago it was considered computationally very expensive and of a sophistication that only experts could use it. The advent of faster hardware and the diffusion of computer codes have brought this technique within the reach of many research groups.

Atomistic simulations frequently operate on microscopic time and length scales: Nanometers and femtoseconds are the basic units in this realm. While a correct description of many observations requires quantum mechanics for a true understanding, the relevant measurements are done on a macroscale. How to consistently go from the micro- to macroscale (and also describe the intermediate mesoscale) remains one of the great unsolved puzzles in computational materials science and was the subject of much discussion at the symposium.

Symposium F on Advanced Materials Education and Training pointed out the new ways and methods for education and training. Media network education is now starting in Europe. Databanks; new software such as fluent, batchcad, oracle, dynamic simulation, molecular modeling, and their applications through a European network; intelligent new materials; corrosion phenomena; and deposition of thin films or electronic materials seems to be key issues for education and training.

Symposium H on Biodegradable Polymers and Macromolecules covered all major aspects which are currently investigated in the field of biodegradable polymers. Various polymer classes such as polyamides, lignin, polyesters, polysaccharides, complex polymeric materials, and rubbers were covered, and aspects of biosynthesis, chemical synthesis, and biodegradation were presented. Other major aspects of this symposium were ecological considerations on the use, application, and production of biodegradable polymers as well as efforts to achieve standardized test methods to investigate and characterize the biodegradability in particular of technical relevant polymers. Economic considerations on the production of technically relevant polymers by the chemical industry, and the prospects for the production of such polymers by means of transgenic plants, were also presented and discussed.

This symposium covered a stimulating mixture of basic research and applied/industrial research, and it brought together scientists with a range of backgrounds and affiliations from many countries worldwide. The relevance of the symposium-topic was confirmed by the attendance of many representatives from the European chemical industry and major companies.

Symposium J on Light-Weight Materials for Transportation presented interdisciplinary information and created a discussion forum between materials scientists and transportation engineers. Papers came from the European car industry (e.g., BMW, Daimler Banz AG; Adam Opel AG, Renault or related companies), and, on the other hand, were given by materials scientists or by high-ranking managers of materials-producing companies. The symposium started with an overview of the materials in the new Roadster of Daimler Benz AG. Aluminum casting, magnesium-application, and fiber-reinforced plastic material in automotive application completed the picture of the advantages using light-weight materials for transportation.

Special new automotive applications are Al-SiC composite brake discs and special composites for bearings and coatings. In the materials area, the papers covered aluminum foams, light-weight carbon fiber rods (which will be used in the next Zeppelin air ship), casting technology of aluminum and magnesium, and laser-beam welding of these materials, as well as research on the behavior of bubbles in welding for repairs in space. Welding, such as friction stir welding, was a special attraction to the audience, as in the connecting technology of new materials (e.g., welding, gluing). There are obvious needs for future development.

At Symposium K on Coatings and Surface Modifications for Surface Protection and Tribological Applications more than 120 papers indicated a very active scientific community and reflected the substantial progress and innovation in a wide range of basic processes and also of the industrial applications that are being made. Important technologies are plasma deposition of coatings on cold rolled steels for long-term corrosion protection, and electron beam physical deposition (EB-PVD) to produce thick adherent gradient coatings for thermal barriers or wear-resistant coatings for high-temperature applications. Many advances in magnetron sputtering technology are stimulated by industrial applications. New approaches using duplex combinations of processes and multilayered or multiphased coatings are very promising for producing coatings to resist specific wear phenomena. Another emerging technology for modification of mechanical surface properties is plasma immersion ion implantation which allows the ability to implant high doses of ions (mainly nitrogen) on all sides of the sample.

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