

Materials Science and Technology in Karlsruhe

By Bernd Eigenmann *

The scientific theme of the annual meeting of the German Society for Metals (Deutsche Gesellschaft für Metallkunde, DGM) held from May 16. to 18., 1989 in Karlsruhe (FRG) was "modern developments in materials science and materials technology". This title not only sketches out the course the DGM is intending to take in future, but also symbolizes the opening of the Society towards modern applications of metallic as well as non-metallic materials in materials science and technology. Since, in many cases, only compound materials of metallic and non-metallic components can meet the increasing specific requirements of modern structures, it appears necessary to include them into the field of activities. The subjects of many workshops of the DGM have already anticipated this trend. During this year's annual meeting, it was finally intended to symbolize the above described new developments in materials science and technology by changing the Society's name to German Society for Materials (Deutsche Gesellschaft für Materialkunde, DGM). This decision was supported by an overwhelming majority of the Society's members, and it terminated a process which lasted for more than a year in which the members of the Society tried to make up their minds about the consequences of the new requirements and tried to reconcile themselves with it.

At the opening ceremony, the president of the DGM, Prof. G. Petzow honored several members of the Society for their excellent research work. Prof. Hans Warlimont (Vacuum-schmelze GmbH, Hanau) was awarded the Heyn Medal, the highest honor of the DGM, in recognition of his extraordinary contributions to the investigation of the basic principles of metallurgy and in the application of these principles to the development of metallic materials.

Dr. Martin Bauser (Wieland Werke AG, Ulm) and Prof. Günther Sauer (Hofmann KG, Wiesbaden) both received honorary memberships of the DGM for distinguished service to the Society, in particular for encouraging strong ties between industrial practice and scientific development.

The Tammann Medal was awarded to Prof. Hans Paul Hougardy (Max Planck Institute for Iron Research, Düsseldorf) recognizing his contribution to the quantitative understanding of structural transformations and their influence on stress in steel, and the Masing Memorial Prize went to Dr. Werner Mader (Max Planck Institute for Metals Research, Stuttgart) for his successful studies of the atomic structure of surfaces at oxide/metal boundaries.

In his annual report, the managing director of the DGM, Dr. V. Schumacher, pointed out that the spreading of the activities of the DGM to non-metallic materials would, however, not lead to an attempt to penetrate step by step into the field of research of other well-established scientific societies in Germany. The aim of the DGM was, according to Dr. Schumacher, rather to deepen interdisciplinary contacts and to promote common activities such as meetings, workshops, and conferences, and, of course, to establish and intensify personal contacts between DGM-members and other scientific organizations.

The annual meeting was terminated by a social evening, on the occasion of which not only a "Brigandebuffet"—whose roots in the history of Karlsruhe were explained by Prof. E. Macherauch—was offered, but also dancing, and finally Prof. F. Thümmeler presented a humorous address to the ladies—especially the wives of scientists.

The annual meeting of the members was embedded in an impressive framework of scientific contributions. The conference was opened by a lecture traditionally dealing with a subject which is not related to materials science. Prof. Wenzel from the University of Karlsruhe, faculty of architecture, talked about the importance of new technologies for the renovation of old buildings. He explained different methods of reinforcing walls and entire buildings, using steel strings and cement and demonstrated how wooden structures can be reinforced either by wood or by steel. Special emphasis was laid on the refined techniques developed in Greece for the purpose of conserving ancient monuments.

During the conference, 10 plenary papers were presented dealing with the various aspects of modern developments in materials science and technology.

Prof. Exner, Max Planck Institute in Stuttgart, presented the advances in quantitative structure analysis. In his lecture, he discussed the stereometry, fractal geometry and mathematical morphology and pointed out the difficulties in describing complex dendritic structures of castings and pores in sintered materials.

Prof. Cherdron, Hoechst AG, Frankfurt, explained the chemical and structural differences between metals and organic polymers. The morphology and molecular structure of polymers was described and correlated with their properties. The theoretical aspects were well illustrated by a number of specific examples such as polymer liquid crystals, composites, and polymer alloys.

Generally, the properties of graphite are known. Up to now, however, they have only been exploited to a relatively

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small extent. Prof. *Hüttinger*, University of Karlsruhe, showed that the high stiffness and toughness of this material up to high temperatures, due to the covalent bonding character in the graphite planes, offer potential applications, especially in the field of carbon fibers. On the other hand, it was shown that an economic production and use of these fibers as well as the minimization of their brittleness and their sensitivity to shear load parallel to the graphite planes still represents a challenge for both scientists and engineers.

Dr. *Meyer*, Thyssen Stahl AG, Duisburg, presented new developments in micro-alloyed steels. He showed that properties like the γ - α -transformation, texture formation, precipitation hardening, and yield strength can be varied over a wide range by small amounts of alloying elements, especially titanium. Good formability can be achieved as well as a high strength dual phase structure.

A survey of the most important methods of surface analysis was given by Dr. *Kirchheim*, Max Planck Institute, Stuttgart. He discussed the state of the art of AES, ESCA/XPS, SIMS, LEED, RHEED and the applications of these techniques to the study of catalyst surfaces, surface passivation, high temperature corrosion, and tribology. Moreover, he explained how inner surfaces can be analyzed, and how the effects of sintering additives in ceramics or the binding mechanisms of metal-polymer composites can be investigated.

Prof. *Holleck*, University of Karlsruhe, showed in an interesting way the relationship between the design and behavior of coatings. He explained the recent developments and trends in obtaining coatings by physical vapor deposition with improved properties, particularly emphasizing coatings with mixed phases, multilayer coatings and gradient coatings.

Prof. Dr. *Hougardy* gave an excellent survey of today's possibilities in calculating residual stresses and distortions resulting from the quenching and hardening processes of steels.

A review of the activities in developing superalloys was given by Dr. *Walser* from Sulzer AG, Winterthur. These efforts are mainly correlated with advances in aircraft and space technology where a permanent improvement of the performance of turbines and combustion chambers is needed. New materials can only be developed on the basis of an increasing knowledge of the influences of metal physics on the materials behavior. Besides the basic science, however,

permanent improvements in production and application techniques of the materials are necessary.

Dr. *Riedel*, Fraunhofer Institute, Freiburg, reported on the modeling of deformation processes during the manufacturing and servicing of engine components. In this case, the term modeling has two meanings. On the one hand, the behavior of the component during manufacturing and service is described by means of numerical models, e.g. finite element calculations, and on the other hand, the derivation of macroscopic materials properties from microscopic models is attempted. For the time being, models for high temperature creep, which exceed the simple Newton creep model, are of particular interest. A model for ternary creep processes was presented, and examples for applications were given.

Finally, Prof. Dr. *Zum Gahr*, University of Karlsruhe, presented new results on the influence of the material used on friction and wear behavior, covering the field of metals, ceramics, and polymers. The wear mechanisms were illustrated, and the materials were classified with respect to their physical and chemical properties. Consequences on the wear behavior in the various tribological systems were explained, and optimized materials combinations were derived from this knowledge.

In addition to the plenary papers, 51 other papers and 145 posters were presented in 3 parallel sessions, covering the fields of plasticity, powder metallurgy, phase transformations, textures, recrystallization, fatigue, temperature resistance, surface layers, thermodynamics and constitution, engineering ceramics, computer aided modeling, fracture, high temperature fatigue, intermetallic phases, residual stresses, wear, interfaces, melting and crystallization, amorphous metals, superconductors, magnetism, composite materials, joining and cutting, and materials for nuclear technology.

The scientific program was enriched by a number of interesting visits to places of cultural and technological importance in and around Karlsruhe and, finally, by a well organized hiking tour through the Pfälzer Wald on Saturday. The wonderful sunny day made it possible to visit four castles in the surroundings of Nothweiler dating from the 12th to the 16th centuries.

Summarizing, one can say that the annual meeting of the DGM gave a well balanced survey of the state of the art in materials science and technology and also valuable insights into future developments.

1990 E-MRS Strasbourg Conferences: (Symposia)

Spring Meeting (May 29. – June 7. 1990)

- A High- T_c Superconductor Materials
- B Metal Matrix Composites
- C Magnetic Thin Films, Multilayers
- D Surface Modification and Coatings
- E Surface Processing and Laser Assisted Chemistry

Fall Meeting (Nov. 27. – 30. 1990)

- A Semiconductors in Optoelectronics
- B Nonlinear Optical Materials
- C Wide Band-Gap Semiconductors
- D Characterization of Compound Semiconductors

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