tion. The device is monolithic, and the addition of the PC layer to the conventional TFEL device requires only one additional step: the deposition of an amorphous silicon alloy using a well-known industrial deposition technique. The simplicity of the new device is an important difference to LCD panels driven by a-Si:H thin-film transistors, a very complex technology. The new TFPCEL structure, although still a prototype, clearly has the potential for use in highly complex display panels, and its high switching speed is compatible with TV applications.

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Conference Reports

Intermetallic Phases

The first German symposium on intermetallics ("Intermetallische Phasen: Grundlagen—Einsatzmöglichkeiten—Herstellung") was held on November 24–25 in Bad Nauheim as a joint meeting of the Deutsche Gesellschaft für Metallkunde (DGM) and the Verein Deutscher Eisenhüttenleute (VDEh). It was attended by materials scientists and engineers—nearly half of them from industry—mostly from Germany, Switzerland and Austria. The symposium was composed of four main sessions:

- fundamentals
- structural materials for high-temperature applications and lightweight materials
- functional materials
- processing technology

and three workshop discussions dealing with the production of engine parts, the boundary conditions for intermetallic materials research, and the prospects of intermetallics for high-temperature applications. The aim was to bring together the various groups in research institutes and industry which are studying intermetallic phases, or are interested in applying intermetallics, in order to review the present situation, to assess the prospects and to define tasks for the future. In this symposium only invited lectures were given, and proceedings are not published.

The introductory lecture was given by *H. J. Engell* (Max-Planck-Institut für Eisenforschung, Düsseldorf) who explained that intermetallic phases occupy a position intermediate between metallic alloys and ceramics with respect to atom bonding and crystal structure. This results in the particular properties of intermetallics which make them promising for high-temperature applications and as functional materials. *E. Parthé* (Univ. of Geneva) discussed the crystal structures of intermetallics and showed that complex crystal structures—e.g. those of the Laves phases—result from the stacking of simple basic structures, planes or columns, which allows the prediction of new structures. The first paper by *J. Hünecke* and *H. Wever* (Tech. Univ. of Berlin) discussed constitutional disorder and its temperature dependence with respect to the β′-Hume-Rothery phases and the $B8_2$ phases NiSb and Ni_3Sn_2. The second paper by *J. Hünecke, H. Wever* and *G. Frohberg* outlined the diffusion mechanisms in intermetallics and applied the analysis to phases of types B2, DO_3, $B8_2$, $L1_2$ and A15. The session on fundamentals was concluded by a review by *P. A. Beaven* (GKSS-Forschungszentrum, Geesthacht) on the possibilities for the ductilization of intermetallics, and in particular the effects of composition, i.e. stoichiometry, macroalloying, microalloying, and of processing were discussed.

The session on structural materials for high-temperature applications was led off by an introductory lecture by *G. Sauthoff* (Max-Planck-Institut für Eisenforschung, Düsseldorf). First an overview was given on the criteria for the selection of phases for high-temperature applications, and on the nickel aluminides and titanium aluminides which are already a subject of materials developments, and are now beginning to be introduced commercially in the USA and Japan. Then some less common phases were described which are of special interest for applications at temperatures above 1000 °C and are a subject of current research. Figure 1 shows some examples.

The oxidation and hot gas corrosion behavior was reviewed by *L. Singheiser* (Asea Brown Bovery, Mannheim). In particular the effects of alloying elements, of impurities

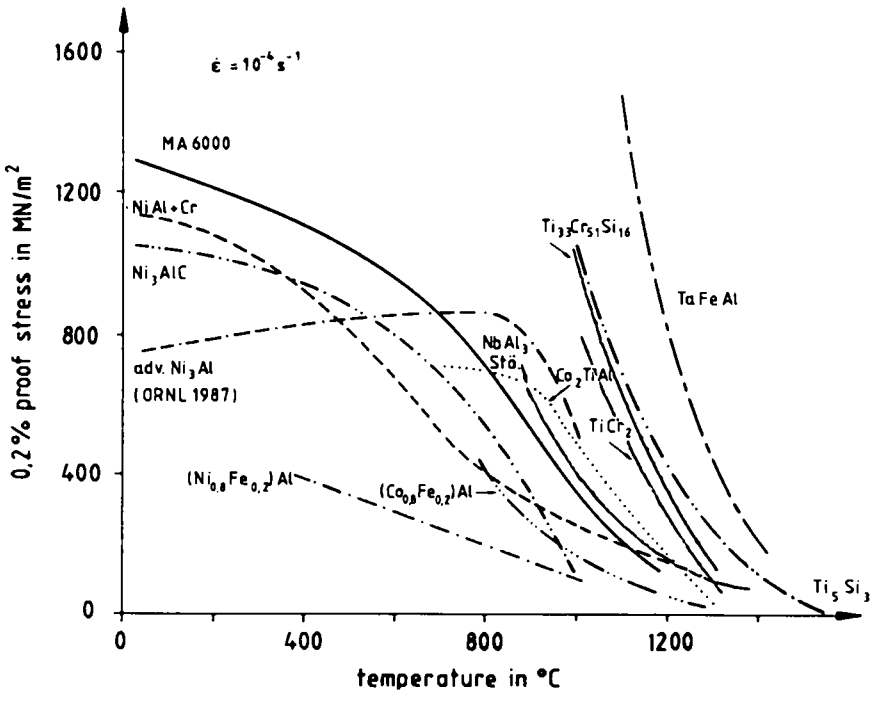

Fig. 1. 0.2% proof stress as a function of temperature for various phases and alloys (Machon, Sauthoff, Frommeyer et al., 1987).

in the atmosphere, and of evaporation of oxides were discussed, and the potential of various phases was evaluated. The creep behaviour of intermetallic phases was analyzed by *G. Sauthoff* and it was shown that the observed behavior can be described by the familiar constitutive equations. Then the possibilities for increasing the creep strengths were discussed, and examples were given with respect to B2 phases and other less common phases. The fatigue behavior was the subject of a paper by *A. Gysler, G. Lütjering* and *I.-G. Park* (Tech. Univ. of Hamburg-Harburg), who have studied the high-temperature fatigue of Al–Mn alloys with large volume fractions of Al_6Mn, in particular crack growth and the effects of atmosphere. As regards lightweight materials, *K.-H. Matucha* (Metallgesellschaft, Frankfurt) reported a current materials development based on Mg_2Si which aims at applications in conventional heat engines. *R. Wagner* (GKSS-Forschungszentrum, Geesthacht) reported work on intermetallic materials based on TiAl, Ti_3Al and Ti_5Si_3. In particular, metallurgical processing and the effects of alloying on microstructure and properties were discussed, and it was shown that both TiAl and the multiphase materials are promising for applications at temperatures up to 1000°C. Nickel aluminides were reviewed by *G. Frommeyer* (MPI für Eisenforschung, Düsseldorf). Ni_3Al and NiAl were discussed with respect to elasticity, plasticity, strengthening and alloying, and the resulting properties were shown.

The session on functional materials was led off by *H. Warlimont* (Vakuumschmelze, Hanau), who reviewed the various functional intermetallics—soft magnetic materials, hard magnetic materials, magnetostrictive materials, superconducting materials, shape-memory materials—with respects to processing and properties. In addition, the commercial importance and the economic potential of these intermetallics was emphasized. Magnetic rare-earth intermetallics were the subject of the paper by *W. Rodewald, W. Fernengel* and *B. Wall* (Vakuumschmelze, Hanau). In particular the properties were discussed and the production techniques were described. Superconducting A15 phases were discussed by *R. Flükiger* (Kernforschungszentrum Karlsruhe) with special reference to the effects of order and stoichiometry on the critial temperature, and a comparison was drawn to the Chevrel phases and the superconducting oxides.

The last session, on processing technology, began with a paper by *W. A. Kaysser* and *R. Laag* (MPI für Metallforschung, Stuttgart) on the fundamentals of powder metallurgy. Methods of powder production were described, the deformability and creep behavior of the powder particles was analyzed, and densification by hot isostatic pressing or hot extrusion was discussed. The report by *H. Grewe* and *W. Schlump* (Krupp Forschungsinstitut, Essen) dealt with the production of components of intermetallics by powder metallurgy. There is evidently a potential for near-net-shape-processed turbine components, the most promising phases being TiAl, Ti_3Al and related materials. The metallurgy of intermetallics was discussed by *G. Frommeyer* (MPI für Eisenforschung, Düsseldorf), with special reference to induction melting and electron-beam melting on the one hand and melt spinning and melt atomization on the other hand. The dependence of the process parameters on the thermodynamic properties of the respective systems was outlined, and examples were given. The thermo-mechanical treatment and forming of intermetallics was discussed by *C. Hartig* (Techn. Univ. of Hamburg-Harburg) with special reference to TiAl-based materials. The basic

principles were outlined and results from current research were presented.

The lectures gave rise to lively discussions which were continued during the breaks and the "Hessen Vesper" party. These many discussions and the workshop results were summarized by *H. Mecking* (Tech. Univ. Hamburg-Harburg) in his concluding remarks in the following way.

- The excellent and perfectly organized programme was a well-balanced presentation of the various aspects of intermetallics and offered a nice opportunity to "look over one's fences".
- This meeting is to be repeated, i.e. there should be a second symposium on intermetallics within two years, with more time for discussions.
- There are three stages of materials development. The first and traditional stage has been development by trial and error, with fundamental research lagging behind applications. The second stage is the optimization of existing materials on the basis of fundamental principles, e.g., as in the case of steels. The third stage is to derive concepts for the development of new materials, which is also the aim of this symposium, and which is supported by research programs of the Federal Ministry of Research and Technology (BMFT) and the German Research Society (DFG). However, the present projects for the development of new intermetallic materials have not been preceded by the necessary fundamental research, and in particular the physical mechanisms which control the plasticity and brittleness of the intermetallics have not yet been analyzed. Thus, much more fundamental research is necessary for achieving new materials developments.
- This fundamental research has to be concentrated on smaller groups of intermetallics, because the whole spectrum of intermetallics is much too broad and divergent. In view of high-temperature applications such a smaller group could be the aluminides and perhaps some silicides.
- Intermetallics have a wide-ranging potential for a variety of applications depending on the particular phases. Materials development on the basis of intermetallics is high tech—even though it may be less fascinating than space research—and must be continued.

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Biomaterials, Bioelectronics ...

Only some months after its foundation the European Institute of Technology (EIT) held its first conference on biotechnology in Verona on 7–8 November 1988. In the opening session *J. M. Marcum,* the president of the EIT, outlined the goals for the EIT in general and for this conference in particular. One of the major tasks defined by the leading companies in chemistry and electronics which have set up the EIT is to act as a mediator between industry and university.

The strategy of the EIT, which is to support and monitor existing centers for the three areas of interest, information technology, materials technology and biotechnology, rather than to set up new groups, seems to be promising and flexible. The EIT will also foster liaison between different groups and catalyze contacts with potential industrial partners.

To define its own position and to initiate first contacts between industry and university the EIT invited more than 40 speakers to Verona. Nine topics, covering the broad range from basic research in biotechnology up to current scientific work with direct commercial applicability, were chosen for this conference, including a special session dealing with the organization and management of research. The first session ranged from the different possibilities for inducing overproduction in plant cell cultures (*G. Kochs* and *H. Grisebach,* University of Freiburg, FRG) up to transgenic plants (*S. Altenbach,* Plant Cell Research Institute, Dublin, USA), and gave an impression of the future importance of these methods. *K. Mosbach* (University of Lund, Sweden) presented interesting results on the production of synthetic enzyme complexes. The method he calls "molecular imprinting" offers a new promising practical approach for the synthesis of selective new materials for purification procedures. The use of enzymes from thermophilic bacteria (*M. Rossi,* University of Naples, Italy) which retain their activity even in mixtures with water-miscible organic solvents could soon become of industrial importance. The wide range of advanced techniques for the isolation of biotechnologically produced substances on a technical scale was described by *M. R. Kula* (KFA Jülich, FRG), *C. R. Lowe* (University of Cambridge, UK) and *M. A. Vijayalakami* (University of Compiègne, France). Concluding with the session on "Genetic and Plasmid Stabilization", the first day offered a program of high "information density" to all participants, covering all current problems in biotechnology.

The second day was devoted to more interdisciplinary sessions, on themes such as "protein engineering" and