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Creep 2008: 11th International Conference on Creep and Fracture of Engineering Materials and Structures

HIGH-TEMPERATURE BEHAVIOUR OF PLATINUM GROUP METALS

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From 4th to 9th May 2008, 149 participants met in Bad Berneck, a small village close to Bayreuth, Germany, for the 11th International Conference on Creep and Fracture of Engineering Materials and Structures, in short, Creep 2008 (1, 2). The attendees came from twenty-two different nations all over the world to participate in Creep 2008, organised by Uwe Glatzel (Metals and Alloys, University Bayreuth, Germany) and by Gunther Eggeler (Research Group for Materials Science and Engineering, Ruhr-University Bochum, Germany). During five days 111 oral presentations were given. The programme was divided into twenty sessions: General I–III, Steel I–VI, Nickel I–III, Refractory I–II, Ti & TiAl, Magnesium, Cu & MMC (Metal Matrix Composites), Steel Welding, Light Metals and Testing Techniques.

Creep deformation is a time-dependent deformation of materials at high temperatures. Hence, the topics of the conference included modelling and simulation of creep deformation, high resolution microanalysis and the development of new high-temperature materials. During the meeting engineers and scientists shared their experience and knowledge in order to explore new materials and applications. A short overview of the talks related to platinum group metals (pgms) is given here.

L. A. Cornish (University of the Witwatersrand, Johannesburg, South Africa) gave an overview of the 'Derivation of the Creep Properties of Two-phase Pt-Al-Cr-Ru Alloys by Modelling'. She presented the development of two-phase Pt-based alloys, which have a similar structure to the well-known and very successful nickel-based superalloys. Progress in developing a thermodynamic database for phase diagram predictions was also presented (see also References (3–5)). The aim of this work is to use these predictions to calculate the volume fraction of the Pt_3Al precipitates, then combine microstructural data derived from a series of different alloy compositions to develop a relationship for the stability of the precipitates. As she pointed out, this allows the size and precipitate distribution against temperature to be modelled for a given alloy composition in the (Pt) and (Pt_3Al) phase field in the Pt-Al-Cr-Ru quaternary system.

K. Maruyama (Tanaka Kikinzoku Kogyo K.K., Japan) reviewed 'High Temperature Creep of GTH (Gottsu-Tsuyoi Hakkin)'. In his talk, high-temperature creep properties of GTH and GTHR, which are trade names of oxide dispersion strengthened platinum alloys developed by the Tanaka Kikinzoku Group, are explained and compared with commercial platinum and platinum-rhodium alloys. It was presented that, comparing the same rupture time; GTHR is several times stronger than the normal Pt-10% Rh alloy, which may be of interest for the glass melting industry for the production of liquid crystal displays and optical glass and the spinning of glass fibres.

The presentation of J. Preußner (Metals and Alloys, University Bayreuth, Germany) addressed the 'Determination of Phases in the System Pt-Al-Cr-Ni and Thermodynamic Calculations'. Pt base alloys have been developed at the Metals and Alloys group to receive creep, oxidation and corrosion resistant alloys for high-temperature applications with room temperature ductility.

Thermodynamic modelling has been used to support the alloy development. The Cr-Pt system has been reassessed with the CALPHAD method based on experimental data and first-principles calculations. He presented a calculated Cr-Ni-Pt ternary phase diagram and an outlook on the calculation of the quaternary Pt-Al-Cr-Ni system.

R. Völkl (Metals and Alloys, University Bayreuth, Germany) summarised the 'Development of a Precipitation Strengthened Pt Base Superalloy'. He reviewed the process of designing an alloy with good mechanical properties and excellent oxidation resistance up to very high temperatures. Similarly to the approach of Cornish (described above), Pt-Al-Cr has been used as a starting point for alloy development. A variety of ternary additions to the Pt-Al base have been investigated to secure the $L1_2$ structure of the hardening Pt_3Al phase. He explained that Ni has been added for solid solution strengthening. A comparison to the common alloy development route in the industry has been shown.

P. Panfilov (Urals State University, Ekaterinburg, Russia) gave a presentation 'On Specific Feature of Plastic Deformation in Iridium'. He stated that the refractory f.c.c.-metal Ir, with a melting point of 2443°C, exhibits excellent mechanical properties at high temperatures. According to experiments he presented, the deformation behaviour of Ir is well in accordance with empirical knowledge on f.c.c.-metals, while some features of Ir seem to be puzzling. He compared the deformation behaviour of single crystals to polycrystalline material at different temperatures. One feature of the deformation behaviour of Ir, he pointed out, is that single crystals show a remarkable total elongation, but no necking, whereas polycrystals only reach a small deformation, but considerable necking. With the help of transmission electron micrographs, Panfilov explained the dislocation structures in deformed Ir samples.

A collection of the conference contributions will be published in a special issue of the journal *Materials Science and Engineering A* (6). The 12th International Conference on Creep and Fracture of Engineering Materials and Structures, Creep 2011, will be held in Japan, and will be chaired by Kouichi Maruyama (Tohoku University) and Hideharu Nakashima (Kyushu University).

References

1 Creep 2008: 11th International Conference on Creep and Fracture of Engineering Materials and Structures: http://www.metalle.uni-bayreuth.de/creep2008

2 Abstract Book for Creep 2008: http://www.metalle.uni-bayreuth.de/creep2008/abstractbook_Creep2008.pdf

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The Reviewers

Johannes Preußner is a scientific researcher and Ph.D. student at the Chair of Metals and Alloys at the University Bayreuth, Germany. His main interests include modelling and simulation in materials science and new high-temperature materials.

Dr.-Ing. Rainer Völkl is senior researcher at the Chair of Metals and Alloys, University Bayreuth, Germany. His main fields of research include alloys of platinum group metals as well as nickel base alloys, testing of mechanical properties at high temperatures and electron microscopy.

Professor Dr.-Ing. Uwe Glatzel is head of the Chair of Metals and Alloys at the University Bayreuth, Germany. His work has had a big impact on the development of modern high-temperature alloys, mainly nickel base superalloys. He advises several research groups, including those working on platinum-based superalloys and other alloys for high-temperature applications, laser metallurgy, material analysis and artificial knee joints.