

Montan-University Leoben
Erich Schmid Institute of Materials Science - ESI
Leoben, Austria

Prof. Dr. Jürgen Eckert
Director of ESI



Presentation Title

Powder Metallurgy of Advanced Materials

Abstract

Among different processing routes, powder metallurgy has a large potential for development of novel high-performance materials thanks to excellent control over phase and microstructure selection, and related physical and mechanical properties. This overview describes methods and process variables employed for synthesis of advanced materials. These methods include mechanical attrition for the production of metastable materials, powder consolidation to create bulk specimens with the desired microstructure and properties, and additive manufacturing for fabrication of parts with intricate and complex geometries. Experimental data for the resulting structures obtained by powder metallurgy of single- and multi-phase materials will be described for selected materials, including nanostructured phases, quasicrystals, composites and metallic glasses, and the mechanisms responsible for phase and microstructure formation and the related properties will be discussed. Consideration of the problems and challenges for powder processing will also be addressed.

Biography

Prof. Dr.-Ing. habil. h. c. Jürgen Eckert works today as the Director of the Erich Schmid Institute of Materials Science at the Austrian Academy of Sciences and the Montanuniversität Leoben, Department Materials Physics. Born in Bayreuth in 1962, he studied Materials Science at the Friedrich-Alexander University (FAU) at Erlangen finishing with his Ph.D. Thesis at summa cum laude at FAU, Siemens Research Laboratories Erlangen and the Research Center Jülich, all in Germany. His first habilitation (venia legendi) was 12-2010 at Dresden University of Technology, Faculty of Mechanical Science and Engineering, Germany.

Research and Professional Experience:

- 12/1985 - 10/1986 Research Assistant, University of Erlangen-Nürnberg, Germany, Dpt. of Materials Science
- 11/1986 - 05/1990 Research Associate, Siemens Research Laboratories, Erlangen, Germany
- 06/1990 - 09/1992 Research Fellow in Materials Science, California Institute of Technology, Division of Engineering and Applied Science, Pasadena, CA, USA
- 10/1992 - 07/1993 Research Associate, SGL Carbon / Ringsdorff-Werke GmbH, Powder Metallurgy Research Laboratory SEL, Bonn, Germany
- 08/1993 - 11/1994 Research Associate / Group Leader "Mechanically Alloyed Materials", IFW Dresden, Institut für Metallische Werkstoffe, Dresden, Germany
- 12/1994 - 03/1996 Senior Research Associate & comm. Head of "Metastable and Nanostructured Materials" Group, IFW Dresden, Institut für Metallische Werkstoffe, Dresden
- 04/1996 – 09/2003 Senior Research Associate Head of "Metastable and Nanostructured Materials" Group, IFW Dresden, Institut für Metallische Werkstoffe, Dresden
- since WS 1997/98 Teaching ("Lehrauftrag"), Institute of Materials Science, TU Dresden
- 01/2000 Appointed Leading Scientist, IFW Dresden, Germany
- 09/2002 – 05/2005 Adjunct Professor, Michigan Technological University, Department of Materials Science and Engineering, Houghton, MI, USA
- 10/2003 – 08/2006 Full Processor and Chair for "Physical Metallurgy", Darmstadt, University of Technology, Dpt. of Materials and Geo Sciences, Darmstadt, Germany
- 09/2006 – 08/2015 Director of the Institute for Complex Materials at the Leibniz-Institute for Solid State and Materials Research Dresden (IFW Dresden) and Full Processor and Chair for "Materials Synthesis and Analysis", TU Dresden, Dpt. of Mechanical Engineering, Institute of Materials Science, Germany
- 2009/2010/2012 Visiting Professor, University Vienna, Institute of Physics, Physics of Nanostructured Materials, Vienna, Austria
- 04/2013 – 06/2014 Scientific Director of the Leibniz-Institute for Solid State and Materials Research Dresden (IFW Dresden)

since 09/2015 Full Processor (Chair "Materials Physics"), Montanuniversität Leoben, Dpt. Materials Physics and Director of the Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences, Leoben and Leoben, Austria

main Research Topics:

- Metastable metallic materials
- Nanostructured high performance materials for functional and structural applications
- Metallic glasses and composites
- Strength and plasticity improvement
- Hard and soft magnetic materials
- Porous bulk materials and hybrid structures for biomedical applications
- Materials for energy applications
- Superconducting materials, surface modification, intermetallic compounds

Awards:

- DGM 1994 Young Scientist Award of the German Materials Research Society (Deutsche Gesellschaft für Materialkunde DGM)
- ISMANAM-95 Young Scientist Award
- FEMS Materials Science and Technology Prize 1997
- Georg-Sachs-Prize 1997 of the Austrian Metal Industry (Stifterverband Metalle und Fachverbandes der Metallindustrie Österreichs)
- IFW Dresden Research Award 2002 for outstanding results in the field of bulk amorphous metals
- Hsun Lee Lecture Award, Institute of Metal Research, Chinese Academy of Sciences and Shenyang National Laboratory for Materials Science, Shenyang, China, April 2006
- Gottfried Wilhelm Leibniz-Prize 2009 of the German Research Foundation (Deutsche Forschungsgemeinschaft DFG)
- ISMANAM-2012 Senior Scientist Award
- Dr. honoris causa (Dr. h. c.) Slovak University of Technology in Bratislava, Slovak Republic (2012)
- ERC-Advanced Grant of the European Research Council (2013)
- DGM-Prize 2014 of the German Materials Research Society (Deutsche Gesellschaft für Materialkunde DGM)

Appointments in Domestic and International Organizations (selected):

- Chairman of the Board of Directors, Materials Research Network Dresden e.V. (MFD) (2006 – 2015)
- Scientific Member of Section D of the Leibniz-Association (since 2009)
- Member of the Faculty of the Department of Mechanical Science and Engineering, TU Dresden (2010 – 2015)
- Member of Scientific Advisory Board of the Stiftung Institut für Werkstofftechnik Bremen
- Member of the International Advisory Committee of the Conference Series "Rapidly Quenched & Metastable Materials (RQ)", International Symposium on Metastable, Mechanically Alloyed and Nanocrystalline Materials (ISMANAM)", Bulk Metallic Glasses (BMG)" and "Nanostructured Materials (NANO)"
- Associate Editor "Journal of Materials Research", "Metals and Materials International", "International Journal of Materials Research (formerly 'Zeitschrift für Metallkunde)", "Powder Metallurgy", "ISRN Metallurgy", Member of Editorial Advisory Board of "Materials Science Foundations"
- Refereeing activities (selected):
- DFG, BMBF, Volkswagenstiftung, Alexander-von-Humboldt-Foundation, DAAD, Bayerische Forschungsförderung, Deutsche Bundesstiftung Umwelt, EU, Schweizerischer Nationalfonds, Österreichische Akademie der Wissenschaften, National Science Foundation NSF (USA), SLAC Stanford (USA), Department of Energy (USA), National University Singapore, Hong Kong Polytechnic University (China), Chinese Academy of Science (China), University of Melbourne, etc.

Publications:

Since 1988: more than 1100 peer reviewed publications in international journals, conference proceedings volumes and book chapters.



About Montan-University Leoben

Based on the 1975 Austrian University Organisation Act, the University of Mining has been known as Montanuniversität Leoben since 1 October 1975.

In 1981 the university held more than 1000 students. A new record was reached with 3700 students in winter semester 2014. The old district court was converted into the Roh- und Werkstoffzentrum (RWZ) in 2006. The new IZW (Impulszentrum für Werkstoffe) was opened in 2007. This houses the academic organisational units, the MCL (Materials Center Leoben) and PCCL (Polymer Competence Center Leoben) competence centres and administrative organisational units for Montanuniversität, linked together via a glass bridge. The renovated lecture theatre wing, with its Erzherzog-Johann-Auditorium was reopened in Autumn 2009. The Polymer Engineering department relocated to the new Zentrum für Kunststofftechnik Leoben in Spring 2010. The former voestalpine research and data-processing centre has been converted into the Kunststofftechnik-Institute. The Impulszentrum Rohstoffe (IZR) opened in 2011, housing the research activities for the Mineral Resources Engineering and Petroleum Engineering departments.

About Erich Schmid Institute of Materials Science - ESI

The Erich Schmid Institute of Materials Science (ESI) Performs cutting-edge research setting the ground for new material concepts, educates outstanding students and scientists in Materials Science and collaborates with leading industrial and scientific partners.

The institute concentrates its research currently on Structural Materials (e.g. steel, alloys, composites, biological materials), Materials for Information Technology (flexible metal-polymer systems, thin film structures, n-BaTiO₃), Materials for Energy and High Temperature Applications (refractory metals, intermetallics), and novel Bulk Nanocrystalline Materials (e.g. nano-composites, magnetic nano-materials). ESI is pushing the frontiers in understanding microstructure – property relationships by combining advanced experimental and modeling techniques. This is a huge challenge since the length scales involved in materials science span nearly 10 orders of magnitude, from atomic structures to macroscopic devices and components.