中德先进材料及技术研讨会

2009 年 5 月 18 日–20 日

主席:　　卢柯院士
　　Manfred Rühle 教授

主办单位:
　　沈阳市人民政府
　　德国联邦教育科研部

承办单位:
　　沈阳市科技局
　　中国科学院金属研究所
　　德意志学术交流中心(DAAD)

支持单位:
　　中华人民共和国科技部

Sino-German Joint Symposium on Advanced Materials and Technology

May 18-20, 2009

Chairs: Prof. Lu Ke
　　Prof. Manfred Rühle

Sponsored by
Municipal Government of Shenyang
German Federal Ministry of Education and Research

Organized by
Science and Technology Bureau of Shenyang
Institute of Metal Research (CAS)
German Academic Exchange Service (DAAD)

Supported by
Ministry of Science and Technology of the P.R. China

Programme

17. 05. 2009 – Sunday

18:30	Reception	Vice-Mayor of Municipal Government of Shenyang, Director LU Ke, Director Stefan HASE-BERGEN, First Counsellor Dr. Matthias HACK, German researchers
18:30-18:45	Group Photo	
18:45	Dinner at Intercontinental	

18. 05. 2009 – Monday

08:50	Registration for workshop

Opening, Address of Welcome

09:00-09:05	Introduction, Moderation: Director of Institute of Metal Research Prof. LU Ke
09:05-09:15	Director of Science and Technology Bureau of Shenyang
09:15-09:25	German Embassy to Beijing First Counsellor Science and Technology Dr. Matthias HACK
09:25-09:30	German Academic Exchange Service Beijing (DAAD) Mr. Stefan HASE-BERGEN

Session I
Presentations (app. 30 min. including Q&A)

	Chair	Prof. LU Ke (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
09:30-10:00	presentation (1)	Prof. Manfred RUEHLE Topic: Quantitative Analysis of Interface Structures by Different Transmission Electron Microscopy Techniques (Max Planck Institute for Metals Research)
10:00-10:30	presentation (2)	Prof. ZHOU Yanchun Topic: Challenges for the layered ternary carbides and nitrides ceramics (MAX phases) (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
10:30-10:40	Group Photo	
10:40-11:00	Coffee break	

Session II
Presentations (app. 30 min. including Q&A)

	Chair	Prof. Manfred RUEHLE (Max Planck Institute for Metals Research)
11:00-11:30	presentation (3)	Prof. LU Lei Topic: Revealing the strengthening mechanism in Cu with nano-scale twin boundaries (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
11:30-12:00	presentation (4)	Prof. Michael GIERSIG Topic: Nanomaterials and their potential applications (Freie Universitaet Berlin, Department Physics, Institute for Experimental Physics)
12:00-13:00	Lunch at IMR	
13:00-14:00	Rest	

Session III
Presentations (app. 30 min. including Q&A)

	Chair	Prof. ZHOU Yanchun (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
14:00-14:30	presentation (5)	Prof. XU Jian Topic: “3D-Pinpointing” Approach: Discovering Large-size Bulk Metallic Glasses in Quaternary Alloy Systems (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
14:30-15:00	presentation (6)	Dr. Dirk HOLLAND-MORITZ Topic: Materials design from the melt (Institute of Materials Physics in Space, German Aerospace Center (DLR) in the Helmholtz Association)
15:00-15:30	presentation (7)	Prof. DU Kui Topic: Electron microscopy study of intermetallics in Cu-Sn alloy (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
15:30-15:50	Coffee break	

Session IV
Presentations (app. 30 min. including Q&A)

	Chair	Prof. Hael MUGHRABI (University of Erlangen-Nürnberg)
15:50-16:20	presentation (8)	Prof. ZHANG Guangping Topic: Effects of length scale and interface on deformation and fracture of metallic multilayer (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
16:20-16:50	presentation (9)	Prof. NICKEL Klaus G. Topic: Oxidation of Silicon carbide: From basics to tribology (Eberhard-Karls-University Tuebingen, Faculty for Geosciences, Applied Mineralogy)
16:50-17:20	presentation (10)	Prof. WANG Jingyang Topic: Design damage tolerant and “ductile” ceramics by nano-laminated integration inside unit cell (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
18:00	Welcome Banquet at Huaren Jiudian	

19. 05. 2009 – Tuesday

Session I
Presentations (app. 30 min. including Q&A)

	Chair	Prof. Karl Ulrich KAINER (Magnesium Innovation Center Mag IC, GKSS Research Centre Geesthacht, Max-Planck-Straße 1, 21502 Geesthacht, Germany)
09:00-09:30	presentation (11)	Prof. Hael MUGHRABI Topic: Cyclic Slip Irreversibilities and the Evolution of Fatigue Damage (University of Erlangen-Nürnberg)
09:30-10:00	presentation (12)	Prof. ZHANG Zhefeng Topic: Deformation mechanisms and mechanical properties of Cu and Cu-Al alloys subjected to equal channel angular pressing (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
10:00-10:30	presentation (13)	Prof. Oliver KRAFT Topic: Plasticity at Small Scales (Institute of Materials Research (IMF II) and Institute for Reliability of Components and Systems (IZBS), University of Karlsruhe)
10:30-10:50	Coffee break	

Session II
Presentations (app. 30 min. including Q&A)

	Chair	Prof. XU Jian (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
10:50-11:20	presentation (14)	Prof. HAN En-Hou Topic: Advanced Wrought Magnesium Alloy and Corrosion Protection Technologies (Institute of Metal Research, CAS)
11:20-11:50	presentation (15)	Prof. Karl Ulrich KAINER Topic: Magnesium based implant materials (Magnesium Innovation Center Mag IC, GKSS Research Centre Geesthacht, Max-Planck-Straße 1, 21502 Geesthacht, Germany)
12:00-13:00	Lunch at IMR	
13:00-14:00	Rest	

Session III
Presentations (app. 30 min. including Q&A)

	Chair	Prof. ZHANG Zhefeng (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
14:00-14:30	presentation (16)	Dr. Matthias OECHSNER Topic: Towards 2020 – Siemens' Perspective on Materials Needs for Advanced Gas Turbines of the Future (Siemens Gas Turbine Parts Ltd., Shanghai, China)
14:30-15:00	presentation (17)	Prof. ZHANG Jian Topic: Directional Solidification by Liquid Metal Cooling Process (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
15:00-15:30	presentation (18)	Dr. JI Weiguo Topic: Potentials and Future Prospects of Compound Cast Back up Rolls in Medium Size (Gontermann-Peipers GmbH)
15:30-15:50	Coffee break	

Session IV
Presentations (app. 30 min. including Q&A)

	Chair	Dr. Matthias OECHSNER (Siemens Gas Turbine Parts Ltd., Shanghai, China)
15:50-16:20	presentation (19)	Prof. LI Dianzhong Topic: Modelling and Experimental Activities for the Heavy Castings and Heavy Forgings: Some Experiencess (Shenyang National Laboratory for Materials Science, Institute of Metal Research, CAS)
16:20-16:50	presentation (20)	Prof. HU Qingmiao Topic: First principles investigations of engineering alloys (Institute of Metal Research, CAS)
16:50-17:10	Conclusion	Prof. LU Ke Prof. Manfred RUEHLE
17:30	Dinner at IMR	

20.05.2009 – Wednesday

09:00-10:30	Visit IMR and SYNL
10:30-12:00	Free discussion
12:00-13:00	Lunch
14:00-18:00	Sightseeing near Shenyang - Liaoning History Museum - Dongling Park
18:00-20:00	Dinner at TV-Tower

同行德中

Deutschland und China –
Gemeinsam in Bewegung

DEUTSCH-CHINESISCHES
Jahr der Wissenschaft und Bildung
德中科学教育年
2009/10

Sino-German Joint Symposium on Advanced Materials and Technology

18/05/2009 – Monday

SESSION I (09:30-10:30)

Professor Manfred RUEHLE
Topic: Quantitative Analysis of Interface Structures by Different Transmission Electron Microscopy Techniques
Professor ZHOU Yanchun
Topic: Challenges for the layered ternary carbides and nitrides ceramics (MAX phases)

SESSION II (11:00-12:00)

Professor LU Lei
Topic: Revealing the strengthening mechanism in Cu with nano-scale twin boundaries
Professor Michael GIERSIG
Topic: Nanomaterials and their potential applications

SESSION III (14:00-15:30)

Professor XU Jian
Topic: "3D-Pinpointing" Approach: Discovering Large-size Bulk Metallic Glasses in Quaternary Alloy Systems
Dr. Dirk HOLLAND-MORITZ
Topic: Materials design from the melt
Professor DU Kui
Topic: Electron microscopy study of intermetallics in Cu-Sn alloy

SESSION VI (15:50-17:20)

Professor ZHANG Guangping
Topic: Effects of length scale and interface on deformation and fracture of metallic multilayer
Professor Klaus G. NICKEL
Topic: Oxidation of Silicon carbide: From basics to tribology
Professor WANG Jingyang
Topic: Design damage tolerant and "ductile" ceramics by nano-laminated integration inside unit cell

德国
灵感与创新
Deutschland
Land der Ideen

IMR

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

RUEHLE | **Manfred**

Surname | Name

Deputy Director

Position(s) and academic title(s)

Max-Planck-Instiutut für Metallforschung
Heisenbergstr.3
D-70569 Stuttgart/Germany

Research institution(s)

Short biography

Since 1.3. 2009	Acting Director, Department LDMM at MPI-MF
01.04.2006	Emeritus Director
1989-present	Scientific Member and Director at the MPI für Metallforschung, Stuttgart
	Honorary Professor, University of Stuttgart, Stuttgart
1994-1999	Executive Director of the MPI für Metallforschung, Stuttgart
1993-1996	Director of the Institut für Werkstoffwissenschaft at MPI-MF, Stuttgart
1991-1993	Interim Director at the MPI für Mikrostrukturphysik, Halle/Saale
1986-1989	Professor, Materials Department, UCSB, Santa Barbara, CA/USA
1971-1986	Group Leader, Electron Microscopy Unit, MPI für Metallforschung, Stgt
1970-1971	Visiting Scientist, Materials Science Division, ANL, Argonne, IL/USA
1967-1970	Post Doc and Research Associate, MPI für Metallforschung, Stuttgart

Publications shortlist

Atomic and Electronic Characterization of the a[100] Dislocation Core in $SrTiO_3$. Z. Zhang, W. Sigle, and M. Rühle, Phys. Rev. B 66 (2002) 094108-1-8.

Direct Atom-Resolved Imaging of Oxides and its Grain Boundaries. Z. Zhang, W. Sigle, F. Phillipp, and M. Rühle, Science 302 (2003) 846-849.

Electrical and Structural Characterisation of a Low Angle Tilt Grain Boundary in Iron-Doped $SrTiO_3$. R.A. De Souza, J. Fleig, J. Maier, O. Kienzle, Z. Zhang, W. Sigle, and M. Rühle, J. Am. Ceram. Soc. 86 (2003) 922.

SESAM: Exploring the frontiers of electron microscopy. C.T. Koch, W. Sigle, R. Höschen, M. Rühle, E. Essers, G. Benner, and M. Matijevic, Microscopy and Microanalysis 12 (2006) 506-514.

Control of bonding and epitaxy at copper/sapphire interface. S.H. Oh, C. Scheu, T. Wagner, and M. Rühle, Applied Physics Letters 91 (2007) 141912-141914.

Research field and interest

Microstructure-properties relationship of advanced materials. Microstructural characterization of high performance materials with emphasis on transmission electron microscopy, including high-resolution and analytical electron microscopy, structure of grain boundaries in ceramics, analysis of atomistic structure of interfaces, determination of chemical composition of materials with high spatial resolution, bonding and debonding mechanisms at interfaces. Displacive transformations in inorganic materials.

Topic of speech in workshop

Quantitative Analysis of Interface Structures by Different Transmission Eloctron Microscopy Techniques

Abstract

Understanding the properties of interfaces requires the knowledge of the (three-dimensional) atomic structure of the interface with high precision. With today's advanced TEM instrumentation it should be possible to get interesting results with a high reliability. Possible approaches for a quantitative interface analysis will be introduced and applied to interfaces between metals (e.g., Cu, Pd, Cr) and different oxides ($SrTiO_3$, ZnO). TEM observations are summarized for coherent, partial coherent and "incoherent" interfaces. Most detailed information were obtained for the Pd/$SrTiO_3$ and Cu/Al_2O_3 interfaces. The positions of columns of atoms (ions) could be determined with high precision. Results on other interfaces will be reported and critically discussed. Implications will be presented

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

周延春

Chinese name (汉字)

ZHOU Yanchun

Western name or pinyin (surname, name)

Professor and Director of High-performance Ceramic DIvision, SYNL

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Dr. Yanchun Zhou obtained his B. S. of ceramics from Tsinghua Univerisity in 1985, M.S. of ceramics in 1988 and Ph.D of metallic materials and heat treatment in 1991,both from Institute of Metal Research, Chinese Academy of Sciences. Before joining IMR, he worked as a visiting scientist in Institute of Strength Physics and Materials, Russian Academy of Sciences during March to July 1991, and a post-doctoral associate at Material Research Center, University of Missouri-Rolla during 1992-1994. He was promoted an associate professor in 1993 and a full professor in 1994. He is now a professor and director of High-performance Ceramic Division, Shenyang National Laboratory for Materials Science, vice-chairman of Academi Committee of Institute of Metal Research, Chinese Academy of Sciences.

He serves as Executive Vice Editor-in-Chief, Journal of Materials Science and Technology, Associate Editor, Journal of the American Ceramic Society ,

Associate Editor, International Journal of Applied Ceramic Technology and Chairman of the International Committee of the Engineering Ceramic Division of the American Ceramic Society.

Publications shortlist

Dr. Zhou has published more than 250 scientific papers in peer-reviewed international journals such as J. Am. Ceram. Soc., J. Europ. Ceram. Soc., Acta Mater., J. Mater. Res., Appl. Phys. Lett., Phys. Rev. B, Chem. Mater., J. Appl. Phys., J. Phys. Conden. Matter., Z. Metallkd., J. Mater. Chem., Mater. Res. Innovat. et al and given more than 30 invited talks in international conferences and workshops. His papers were highly cited more than 2600 times.

Y. C. Zhou, Fanling Meng, Jie Zhang "New MAX-phase compounds in the V-Cr-Al-C system" J. Am. Ceram. Soc. 91(4)1357-1360(2008)

C. F. Hu, J. Zhang, J. M. Wang, F. Z. Li, J. Y. Wang and Y. C. Zhou "Crystal structure of V_4AlC_3, a new layered ternary carbide" J. Am. Ceram. Soc. 91(2)636-639(2008)

C. F. Hu, F. Z. Li, J. Zhang, J. M.. Wang, J. Y. Wang, and Y. C. Zhou "Nb_4AlC_3, a new compound belonging to the MAX phases" Scrip Mater. 57(10)893-896(2007)

Y. C. Zhou and J. X. Chen " Mechanism for the strengthening of Ti_3AlC_2 by incorporation of Si to form $Ti_3Al_{1-x}Si_xC_2$ solid solutions" Acta Mater. 54(5)1317-1322(2006)

Research field and interest

1) Multi-scale (electronic, crystal and microstructural) designing and processing of high-temperature ceramics and composites;
2) Developing low-cost techniques for the processing of bulk and low-dimensional (powders and thin films) materials;
3) Investigating the mechanical behavior under static, dynamic and cyclic loads;
4) Investigating thermal/chemical stability of ceramics and composites in ultrahigh temperature environment.

Topic of speech in workshop

Challenges for the layered ternary carbides and nitrides ceramics (MAX phases)

Abstract

The layered ternary compounds $M_{n+1}AX_n$ (called MAX phases), where M is a transition metal, A is a IIIA or IVA element, X is C or N, combine the merits of both metals and ceramics. The salient properties of this family of materials include low density, high strength and modulus, damage tolerance at room temperature, good machinability, and being resistant to thermal shock and oxidation. The unique combination of these properties make them possible for applications in aerospace industry, GIV nuclear reactors, solid oxide fuel cell, metallurgy, etc., as either structural components or as corrosion resistant coatings. However, the high fabrication cost, rapid decrease of strength at high temperatures, decomposition at high temperatures in vacuum or reaction with environmental gases limit their widespread applications. To overcome these application obstacles, low cost methods such as pressureless sintering, reaction/diffusion bonding for the production of bulk components, solid solution strengthening or reinforcing with particulate phases such as TiB_2, formaton of protective layers at high temperatures, must be developed. In this talk, challenges for the application of MAX phases in different environment will be discussed, and methods to reduce the fabrication cost and improve the properties will be addressed.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

卢磊

Chinese name (汉字)

LU Lei

Western name or pinyin (surname, name)

Shenyang National Laboratory for Materials Science,
Institute of Metal Research,
Chinese Academy of Sciences

Position(s) and academic title(s)

72 Wenhua Road, Shenyang 110016, PR China

Research institution(s)

Short biography

Lei Lu is a Professor in Shenyang National Laboratory for Materials Science at Institute of Metal Research, Chinese Academy of Sciences. She received her Ph.D from IMR in 2000. She was a visiting scientist at MIT in 2004 & 2008. Lu's research focuses on the synthesis, microstructure characteristic and mechanical properties of nanocrystal and nano-twinned metallic materials. She authored and co-authored more than 40 international journal publications (including Science, Acta Mater. etc), held 6 patents, and presented 7 invited lectures at international conferences. Lu received the "Hundred Excellent Ph.D Dissertation in China" award in 2002 and the "Top Prize of the President Scholarship of CAS" award in 2000.

Publications shortlist

L. LU, X. CHEN, X. HUANG, K. LU
Revealing the maximum strength in nano-twinned copper
Science, 323 (2009) 607-610.

K. Lu, L. LU, S. Suresh
Strengthening materials by engineering coherent internal boundaries at the nanoscale
Science, 324 (2009) 349-352.

L. LU, Y.F. SHEN, X.H. CHEN, L.H. QIAN and K. LU
Ultrahigh strength and high electrical conductivity in copper
Science, 304 (2004) 422-426.

L. LU, M.L. SUI, K. LU
Superplastic extensibility of nanocrystalline copper at room temperature
Science, 287, (2000) 1463-1466.

L. LU, R. SCHEAIGER, Z. SHAN, M. DAO, K. LU, S. SURESH
Nano-sized twins induce high rate sensitivity of flow stress in pure copper
Acta Mater., 2005, 53, 2169-2179.

Research field and interest

synthesis and processing, microstructure characterization, deformation and mechanical properties of nano-structured metallic materials

Topic of speech in workshop

Revealing the strengthening mechanism in Cu with nano-scale twin boundaries

Abstract

The strength and ductility of the nanostructured metals are strongly influenced by its internal boundaries and defects. Whereas the strengthening mechanisms of the conventional high-angle grain boundaries have been well studies in the naocrystalline metals, in this presentation, we will focus on the recent systematic experimental investigations of the strengthening mechanism relative to the coherent twin boundaries. The twin lamellar thickness dependence on the strength, ductility and work hardening will be discussed in a series of pure copper samples with different twin thicknesses (from 100 nm to 4nm) prepared by using the pulsed electro-deposition. Twin boundary serves as an effective barrier against dislocation transmission and strengthening Cu in a manner similar to the way grain boundaries. In contrast, however, the nanotwinned Cu achieves very high strength without compromising its ductility. In particular, a maximum strength was found in the nanotwinned Cu at a twin thickness of 15 nm, which followed by a rapid softening and a monotonic enhancement in both the strain-hardening and ductility at smaller twin thicknesses. These unique properties and related dislocation–twin boundary strengthening mechanism differ fundamentally from that of the dislocation-grain boundary strengthening mechanism. These findings provide insights into the possible promising routes for optimizing the mechanical properties of nanostructured metals by tailoring internal interfaces.

Notes

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Personal information

GIERSIG	**Michael**
Surname	Name

Prof. Dr.

Position(s) and academic title(s)

Head of the Nanomaterials and Nanotechnology group at the Physics department

Research institution(s)

Freie University Berlin

Short biography

Professor of Physics at the Bonn University and at the Freie University of Berlin; department physics; in charge of the research group “Nanomaterials for application in electronic and live sciences”
1975-1979 study of physics, A. Mickiewicz University in Poznan, Poland;
1984 diploma in physics at the Freie University of Berlin;
1988 PhD in chemistry at the Freie University of Berlin;
1999 habilitation, University of Potsdam in Physical Chemistry;
More than 220 reviewed publications and over 120 conference contributions, 6 Patents, 3 book contributions; h-Index: 50.
Research Award: 2007- First Degree Medal for outstanding contribution to the development of the Faculty of Physical Engineering of the Czech Technical University in Prague; 2006- Awarded title "Professor of Physical Science" by the President of the Republic of Poland; 2005- Fulbright Award for research at Boston College and Harvard Medical School, USA; 1995- 1996 International Research Accolade at the University of Melbourne, Australia; Dept. Physical Chemistry

Publications shortlist

Spontaneous organization of single CdTe nanoparticles into luminescent nanowires
Tang ZY, Kotov NA, Giersig M ; SCIENCE 297, 5579, 237-, 2002
Synthesis of nanosized gold-silica core-shell particles
LizMarzan LM, Giersig M, Mulvaney P; LANGMUIR 12, 18, 4329-, 1996
Electrostatic self-assembly of silica nanoparticle - polyelectrolyte multilayers on polystyrene latex particles
Caruso F, Lichtenfeld H, Giersig M, et al. J.A.C.S. 120, 33, 8523-, 1998
Preparation, characterization, and photophysics of the quantum-dot quantum-well system CdS/HgS/CdS
Mews A, Eychmuller A, Giersig M, et al. J. PHYSICAL CHEMISTRY 98, 3, 934-, 194
Formation of colloidal silver nanoparticles: Capping action of citrate
Henglein A, Giersig M,
JOURNAL OF PHYSICAL CHEMISTRY B 103, 44: 9533-, 1999

Research field and interest

The work of my group is focussed on the creation of 2-D and 3-D nanostructures, based on single nanoparticles, as well as on the fabrication of nanostructured surfaces with a size of a number of square centimeters. The optical, structural, and magnetic characterization of nanostructures as well as their potential applications in optics, photonics, and biomedicine, especially the application of nanomaterials for cell manipulation, tissue engineering, biosensors, and cell growth are the most important aspects.

Topic of speech in workshop

Nanomaterials and their potential applications

Abstract

Nanoscale materials composed of either metal or semiconductor as well as magnetic particles play an increasingly important role as novel bulding blocks in physical chemistry, physics, material science and also in biomedicine. Because of the high surface to volume ratio of nanoparticles, the surface properities have significant effects on their structural ,optical, electronic and magnetic properties. For example, in semiconductor particles the quantum confinement of both electrons and holes in all three dimensions leads to an increase in the effective band gap of the material with decreasing particle size. Consequently , both the optical absorption and emission of these particles shift to the lower wavelenght as the size of the dots gets smaller.Therefore, the precise control of size and morphology of nanoparticles is of significant importance with respect to the creation of nanoparticles with desired optical or electronic characteristics. In the second part, the principle of the assembly method and especially nanospherlithography will be discussed. This technology permits the production of large arrays of two–dimensional nanostructures with required sizes and morphologies made up of varoius composition. In this lecture we will discuss wet chemistry and physical methods for the creation of nanoparticles with such characteristics and give exampels of potential application in electronics and biomedicine.

Notes

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Personal information

徐坚

Chinese name (汉字)

XU Jian

Western name or pinyin (surname, name)

Group Leader, Professor

Position(s) and academic title(s)

Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

B. Eng., majoring in Materials Engineering, 1982, Dalian University of Technology

Visiting Scholar, 10/1994-9/1995, University of Illinois at Urbana-Champaign, USA.
Research Associate, 10/1995-6/1996, Louisiana State University, USA.
Research Associate, 7/1996-4/1998, University of Michigan, USA.
Guest Scientist, 8/1999-11/1999, Max-Plank Institute for Metal Research, Germany.
Research Professor, Group Leader, 3/2001-present, Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences.

Publications shortlist

Y. Li, S.J. Poon, G.J. Shiflet, J. Xu, D.H. Kim, J.F. Löffler, Formation of bulk metallic glasses and their composites, MRS Bull. 32 (2007) 624.

H. Ma, L.L. Shi, J. Xu, Y. Li, E. Ma: Discovering inch-diameter metallic glasses in three-dimensional composition space, Appl. Phys. Lett. 87 (2005) 18195.

Y.K. Xu, H. Ma, J. Xu, E. Ma: Mg-based bulk metallic glass composites with plasticity and gigapascal strength, Acta Mater. 53 (2005) 1857.

H. Ma, J. Xu, E. Ma: Mg-based bulk metallic glass composites with plasticity and high strength. Appl. Phys. Lett. 83 (2003) 2793.

L. Zhang, Y.Q. Cheng, A.J. Cao, J. Xu, E. Ma, Bulk metallic glasses with large plasticity: composition design from the structural perspective, Acta Mater. 57 (2009) 1154.

Research field and interest

- Bulk Amorphous Metallic Materials
- Light-weight Alloys

Topic of speech in workshop

"3D-Pinpointing" Approach: Discovering Large-size Bulk Metallic Glasses in Quaternary Alloy Systems

Abstract

As a new family of engineering materials, bulk metallic glasses (BMGs) are of considerable interest due to their high strength, high elastic limit, wear and corrosion resistance, and near-net shape processibility. Over the past decade, a number of new alloys with high glass-forming ability (GFA) were developed, where centimeter-scale BMGs can be made especially in the alloys based on the usual and low-cost metals such as Cu, Mg, Fe. However, the search for large-size BMGs has been suffering from the lack of an established practical method to navigate in multi-component composition space.

To address this issue, we developed a new method to track down the best BMG former in a composition tetrahedron (in a pseudo-ternary or quaternary system). We have made use of our 3D protocol to systematically assess the effects of the element substitution via the shapes of the contours of the BMG-forming zones in the composition tetrahedron. Advantage of our approach is to uncover the full potential of GFA in a given system. This effort allows us to discover new BMGs with large critical size (Dc) in quaternary systems, such as Mg54Cu28Ag7Y11 (Dc=16mm), Mg57Cu31Y6.6Nd5.4 (Dc=14mm), Mg59.5Cu22.86Ag6.64Gd11 (Dc=27mm), Cu44.25Ag14.75Zr36Ti5 (Dc=10mm), Cu42Zr44.4Y3.6Al10 (Dc=16mm), Ni56Co3Nb36Sn5 (Dc=3mm) and Ti44.2Zr7.8Cu38Ni10 (Dc=3mm). These findings are significant to develop the BMGs with a good combination of modest size and unique mechanical properties and then to bring exotic laboratory wonders to marketplace.

Notes

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Personal information

HOLLAND-MORITZ **Dirk**

Surname Name

Priv.-Doz. Dr.

Position(s) and academic title(s)

Institut für Materialphysik im Weltraum,
Deutsches Zentrum für Luft- und Raumfahrt (DLR)
51170 Köln, Germany

Research institution(s)

Short biography

1985 - 1990: study of physics at the Universität zu Köln, Degree: Diploma

1991 - 1994: Ph.D. thesis at the Institute of Solid State Physics of the Forschungszentrum Jülich and the Institute of Space Simulation of the German Aerospace Center (DLR) under direction of Prof. Dr. K. Urban and Prof. Dr. D.M. Herlach;
Ph.D. examination at the Rheinisch-Westfälische Technische Hochschule Aachen

2004: Habilitation at the faculty of physics and astronomy of the Ruhr-Universität Bochum in the field of experimental physics;
Private lecturer of experimental physics at the Ruhr Universität Bochum since 05.05.2004

since 01.06.2001: Scientific employee at the Institute of Materials Physics in Space of the German Aerospace Center (DLR)

Awards:

30.06.1995: Borchers Plakette of the Rheinisch-Westfälische Technische Hochschule Aachen, Germany

31.08.1995: Hugo-Denkmeier-Award of the DLR

2003: Science Award of the DLR

Research Stays Abroad:

05.1999 - 04.2000: Harvard University, Division of Engineering and Applied Sciences, research group of Prof. Dr. F. Spaepen

Publications shortlist

C. Notthoff, B. Feuerbacher, H. Franz, D.M. Herlach, and D. Holland-Moritz
Direct Determination of metastable phase diagrams by synchrotron radiation experiments on undercooled metallic melts
Phys. Rev. Lett. 86, 1038 (2001).

T. Schenk, D. Holland-Moritz, V. Simonet, R. Bellissent, and D.M. Herlach
Icosahedral Short-Range Order in Deeply Undercooled Metallic Melts
Phys. Rev. Lett. 89, 075507 (2002).

K.F. Kelton, A.L. Greer, D.M. Herlach, and D. Holland-Moritz
Influence of Order on the Nucleation Barrier
Materials Research Society Bulletin 29, 940 (2004).

D.M. Herlach, P. Galenko, and D. Holland-Moritz
Metastable solids from undercooled melts
Pergamon Materials Series, edited by R.W. Cahn, Elsevier (2007).

D. Holland-Moritz, S. Stüber, H. Hartmann, T. Unruh, T. Hansen, and A. Meyer
Structure and dynamics of liquid $Ni_{36}Zr_{64}$ studied by neutron scattering
Phys. Rev. B 76, 064204 (2009).

Research field and interest

- Undercooled metallic melts (structure, dynamics, properties)
- Non-equilibrium solidification of metallic melts
- Nucleation and growth of solid phases in undercooled melts
- Containerless processing techniques
- Neutron scattering and X-ray diffraction (in-situ investigations)
- Quasicrystals

Topic of speech in workshop

Materials design from the melt

Abstract

Wordwide approximately 90 % of all metallic materials are produced by solidification from the molten state, which highlights the enormous economical impact of materials design from the melt.

The materials research activities at the Institute of Materials Physics in Space are aiming to find an improved understanding of solidification processes. Apart from investigations on the solidification behaviour of metallic melts under conditions close to equilibrium, the non-equilibrium solidification from the metastable state of undercooled liquids is intensively studied. In order to deeply undercool the melts below the melting temperature and to avoid chemical reactions with crucible materials, containerless processing techniques such as electromagnetic levitation and electrostatic levitation are applied. These techniques are combined with in situ diagnostics that allow to record temperature time-profiles for studies of the nucleation behaviour, to measure crystal growth velocities as function of the undercooling and to determine a large variety of thermophysical properties such as surface tension, density, viscosity, specific heat and electrical resistivity. The electromagnetic levitation technique was also combined with X-ray diffraction using syncrotron radiation and with elastic and quasielastic neutron scattering. In situ X-ray diffraction allows to investigate the phase selection behaviour during non-equilibrium solidification of undercooled melts with a time resolution better than 1 s and hence to detect the formation of metastable solid phases during solidification even if these phases subsequently transform such that they cannot be found in the as solidified material. X-ray diffraction and elastic neutron scattering enable to investigate the short-range order of stable and undercooled metallic melts which provides the basis of understanding important parameters for modelling of solidification processes such as solid-liquid interfacial energies and thermophysical properties on an atomistic scale. By quasielastic neutron scattering self-diffusion coefficients are determined, which enter in most models of crystal growth.

Other effects that decisively influence the solidification of melts are related with fluid flow. Gravity is one of the key parameters that governs buoyancy-driven fluid flow in liquids. We perform experiments under the special conditions of microgravity that offer the unique opportunity of reducing buoncy-driven fluid flow in melts and hence to establish purely diffusive conditions.

The experimental research activities are accompanied by modelling of crystal nucleation, dendritic growth and properties of metallic melts in order to provide for a predictive capability for materials design from the melt.

This talk gives an overview on the materials research activities at the Institute of Materials Physics in Space.

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Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

杜奎

Chinese name (汉字)

DU Kui

Western name or pinyin (surname, name)

Associate Professor, Dr.

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Having completed a B.Sc. in the Beijing University of Science and Technology, Kui Du came to the Institute of Metal Research, Chinese Academy of Sciences in 1993, and graduated with a Ph.D. in Materials Science in 1999.
After his PhD, Kui Du joined Max-Planck-Institute for Metal Research in Germany as a research scientist and later the Department of Materials Science and Engineering at Case Western Reserve University in the United States as a senior research associate. In 2006, he joined the Institute of Metal Research, CAS as an associate professor.
Kui Du has worked on development of quantitative electron microscopy methods and has developed a software, LADIA, with his colleagues for lattice distortion analysis from high-resolution electron micrographs, which is currently used in research groups around world.

Publications shortlist

X.H. Sang, K. Du, M.J. Zhuo, H.Q. Ye, On the accuracy of maximum entropy reconstruction of high-resolution Z-contrast STEM images. Micron 40, 247-254 (2009).

K. Du, M. Rühle, Image matching between experimental and simulated high-resolution electron micrographs of sapphire on the [0-110] orientation. Journal of Microscopy 232, 137-144 (2008).

K. Du, K.V. Hochmeister, F. Phillipp, Quantitative comparison of image contrast and pattern between experimental and simulated high-resolution transmission electron micrographs, Ultramicroscopy 107, 281-292 (2007).

K. Du, F. Phillipp, On the accuracy of lattice-distortion analysis directly from high-resolution transmission electron micrographs. Journal of Microscopy 221, 63-71 (2006).

K. Du, Y.M. Wang, H. Lichte, H.Q. Ye, Measurement of crystal thickness and orientation from selected-area Fourier transformation of a high-resolution electron hologram. Micron 37, 67-72 (2006).

Research field and interest

Transmission electron microscopy; microstructure and microanalysis of materials

Topic of speech in workshop

Electron microscopy study of intermetallics in Cu-Sn alloy

Abstract

Cu-Sn intermetallic compounds are generally present at the interfaces between solders and conducting substrates in electronic packaging and microelectronic applications. The conducting substrates are commonly made of Cu-based alloys, and Sn is the major element of SnPb-based solders or recently developed lead-free solders. The reaction between Cu and Sn produces Cu3Sn and Cu6Sn5. These intermetallic compounds significantly influence the mechanical behavior and reliability of solder s. Extensive studies have been carried out on the morphology and growth kinetics of the Cu3Sn and Cu6Sn5 intermetallic compounds. However, there are only a few studies on the crystal structures of Cu3Sn and Cu6Sn5. In the present work, we will focus on their crystal structures as well as the defect structures within it.

Cu3Sn has been investigated by transmission electron microscopy and scanning transmission electron microscopy. High density anti-phase boundaries are observed in the crystal, and their translation vector is determined by high-resolution transmission electron microscopy and Z-contrast imaging techniques.

The crystal structure of eta’-Cu6Sn5 has been reported as a variety of long-period superstructures of NiAs-Ni2In type lattice. The superstructures are proposed to be formed by different occupancy of extra Cu atoms that site the interstices of Sn atoms in the crystal lattice in a regular manner. However, atomistic structures of these superstructures are unclear thus far. In order to resolve the structure of eta’-Cu6Sn5, it is crucial to determine the occupancy and position of these extra Cu atoms. Since the distance between the extra Cu atoms and nearest Sn atoms is beyond the resolution limit of a STEM used in recent studies, the maximum entropy reconstruction is desired to resolve the extra Cu atoms and thereby to quantify their occupancy and position from Z-contrast images. For the quantitative analysis, a systematic assessment of the effects of experimental variables and noise on it is essential to ensure the accuracy of the maximum entropy reconstruction. Therefore, we will use the simulated Z-contrast images of eta'-Cu6Sn5 intermetallics to evaluate the accuracy of the maximum entropy reconstruction in which the effects of experimental variables and noise are explicitly taken into account.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

张广平

Chinese name (汉字)

ZHANG Guangping

Western name or pinyin (surname, name)

Professor

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Guang-Ping Zhang obtained his Ph.D. in Materials Physics from Institute of Metal Research (IMR), Chinese Academy of Sciences (CAS) in 1997. After that, he spent two years working on fatigue of advanced materials in IMR, CAS. In 1999, as a postdoctoral fellow he conducted a two-year research on mechanical properties of small-scale materials for microelectromechanical systems in Tokyo Institute of Technology, Japan. In 2002, as a guest scientist he joined ARZT Department at Max Planck Institute for Metals Research, Stuttgart, Germany, and had conducted the study on mechanical properties of thin metal films for twenty months. From 2004, he holds a professor position in IMR. As a group leader, he is now working in Shenyang National Laboratory for Materials Research, IMR and mainly focusing on fundamental research of mechanical properties and reliability of small-scale materials, including thin films/multilayers, metallization interconnects, as well as micro/nanoscale materials.

Publications shortlist

G. P. Zhang, Y. Liu, W. Wang and J. Tan: Experimental evidence of plastic deformation instability in nanoscale Au/Cu multilayers. Appl. Phys. Lett. 88, 013105-1~013105-3 (2006).

G. P. Zhang, X. F. Zhu, J. Tan and Y. Liu: Origin of cracking in nanoscale Cu/Ta multilayers. Appl. Phys. Lett. 89, 041920-1~041920-3 (2006).

G. P. Zhang, C.A. Volkert, R. Schwaiger, P. Wellner, E. Arzt, O. Kraft: Length-scale-controlled fatigue mechanisms in thin copper films. Acta mater. 54, 3127-3139 (2006).

G. P. Zhang, Z. G. Wang and G. Y. Li, “Fatigue Crack Growth of Ni3Al(CrB) Single Crystals at Ambient and Elevated Temperatures”, Acta Mater. 45 (1997) 1705-1714.

X. F. Zhu, Y. P. Li, G. P. Zhang, J. Tan and Y. Liu, Understanding nanoscale damage at a crack tip of multilayered metallic composites. Appl. Phys. Lett. 92 (2008) pp.161905-1~161905-3.

Research field and interest

Mechanical properties of small-scale materials
Fatigue and fracture of advanced materials

Topic of speech in workshop

Effects of length scale and interface on deformation and fracture of metallic multilayers

Abstract

Metallic multilayers made of alternating layers and heterogeneous interfaces have exhibited some different mechanical properties from their constituents. Great research interests of mechanical properties of the multilayers are not only due to their potential applications but also due to the physical mechanisms of strength, deformation, fracture, and fatigue of the material associated with length scale and interfaces. Extensive investigations have shown that metallic multilayers are of very high strength/hardness (about 1/2-1/3 theoretical strength) when individual layer thickness of the multilayer approaches nanometer scale. Physical reasons for strengthening effects are attributed to constraints of the small layer thickness on dislocation activities as well as interface properties. However, deformation instability and fracture behavior of the metallic multilayers is still less understood.

In this talk, we will present our recent research progress in understanding of deformation and fracture behavior of metallic multilayers. Several typical Cu-X (Au, Ta and Cr, etc) multilayers on a silicon substrate and/or flexible organic substrate are investigated by using different mechanical testing methods including indentation and monotonic loading. Plastic deformation instability and fracture behavior of the metallic multilayers with different individual layer thicknesses ranging from nanometer to submicron scale and interfaces are examined. Quantitative analysis and theoretical evaluation of different deformation and fracture behavior of the multilayers will be given to understand the underlying mechanism related to the length scale and interface of the materials.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

NICKEL | **Klaus**

Surname | Name

Professor, PhD, Dipl.-Geol.
Vice Dean

Position(s) and academic title(s)

Eberhard-Karls-University Tuebingen, Faculty for Geosciences, Applied Mineralogy

Research institution(s)

Short biography

1975 - 1979 Study of Geology at the Johannes-Gutenberg University Mainz (Dipl.-Geol.). Diploma thesis "Geological and petrological investigations in the area of the Nahe valley between Norheim and Staudernheim with particular reference to the intermediate magmatites"
1979 - 1983 Dissertation (Ph.D.) at the Faculty for Geosciences at the University of Tasmania, Hobart, Australia: "Petrogenesis of garnet and spinel peridotites. A study with particular reference to the role of chromium in geothermometry and geobarometry."
1983 - 1986 Researcher at the Max-Planck-Institute for Chemistry (Mainz, Germany), Department Cosmochemistry
1986 - 1991 Senior researcher and chair for the group for thermal analysis at the Max-Planck-Institute for Metals Research (Stuttgart, Germany), Department Materials Science, Powdermetallurgical Lab
since 1991 Professor for Applied Mineralogy at the Institute for Geosciences, Eberhard-Karls-University Tübingen,

Publications shortlist

Presser, V., Berthold, C., Wirth, R. & Nickel, K.G. (in press): Structural charac-terisation of tribologically influenced ceramic surfaces.- Current Opinion in Solid State & Materials Science

Nickel, K.G. , Presser, V., Krummhauer, O., Kailer, A. & Wirth, R. (2008): Hydrothermal Oxidation of Silicon Carbide at High Pressure and its Bearing on Wear Mechanisms.- Ceramic Engineering Science Proceedings 29 (3): 143-154

Presser, V. & Nickel, K.G. (2008): Silica on Silicon Carbide.- Critical Reviews in Solid State and Materials Science 33 (1): 1-99

Nickel, K.G. (2005): Ceramic matrix composite corrosion models.- Journal of the European Ceramic Society 25 (10): 1699-1704

Dorn, M.T. & Nickel, K.G. (2004): Zirconia Ceramics: Phase Transformations and Raman Spectroscopy.- In: Gogotsi, Y. & Domnich, S (Ed.): High Pressure Surface Science and Engineering,.- Institute of Physics Publishing, Bristol (UK), p. 466-519

Research field and interest

Main focus are phase relations and kinetics in ceramic systems with particular attention to the problems of oxidation, corrosion, local stresses and tribochemistry. Silicon nitride and carbide based ceramics are major subjects, joined by oxide (Alumina, Zirconia), carbon and ultra-high temperature ceramics for structural applications in harsh chemical and thermal environments. Bioceramics and biomimetics are further subjects of work and interest.

Topic of speech in workshop

Oxidation of Silicon carbide: From basics to tribology

Abstract

Silicon carbide and related materials are applied extremely diverse: as abrasives, refractories, bearings, heat exchangers, structural parts, semiconductors or electronics. However, one property, which is basic to all of those applications, is the chemical stability under manufacturing or application conditions. It will be shown that important questions on the basic behavior are answered only now with advanced methods and techniques.
The review will focus on two special cases: The oxidation behaviour of single crystals, which is crucial for the manufacturing of electronic and semiconducting devices from SiC and the hydrothermal behavior, which is crucial to the problem of the wear behavior in water lubricated systems.
The combination of AFM and etching allows to follow the details of the growth and simultaneous crystallisation of the scale on single crystals during thermal oxidation. Models allow to clarify diffusion coefficient differences and to evaluate the influence of impurities.
New insights into wear problems come from combined static hydrothermal oxidation experiments in a diamond anvil apparatus using wafer-quality single-crystal silicon carbide and observations from transmission electron microscopy from tribological tests on sintered silicon carbide. The evidence points to an active type of oxidation under hydrothermal conditions, i.e. there are no primary condensed reaction products. The formed tribolayer is produced by effects of plasticity of SiC under high pressure, the formation, breaking and cracking of mosaic silicon carbide crystals on the µm to nm-scale and hydrothermal reactions in enclosing and opening void spaces. Hydrothermal pressures of several hundred MPa seem feasible and are seen as responsible both for fatigue and surface roughening as well as the formation of the smooth main wear track, which reduces friction favourably.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

王京阳

Chinese name (汉字)

WANG Jingyang

Western name or pinyin (surname, name)

Professor

Position(s) and academic title(s)

High-performance Ceramic Division, Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, China

Research institution(s)

Short biography

Jingyang Wang finished his bachelor's degree in Physics School of Peking University in 1992; and obtained PhD degree in Institute of Metal Research in 1998. In 2001, he visited International Centre for Theoretical Physics (ICTP) and University of Trento in Italy. Throughout 2007, he visited International Center for Young Scientists (ICYS) in National Institute for Materials Science (NIMS) in Japan.

Jingyang Wang focuses his research interests on multi-scale designing of high-performance ceramics. He investigated the effect of electronic structure, crystal structure, and chemical bonding on the mechanical properties of new oxides, carbides, nitrides and borides including M(M=Ti, Cr, Nb, Ta, Zr, Hf)-Si(Al)-C, Y-Si-O-N and Si-B-O-N systems. He disclosed the intrinsic relationships between atomic- and/or electronic-scale characteristics, and macroscopic performances of these structural ceramics. On these scientific achievements, he has published more than 110 scientific papers in peer-reviewed journals; and in addition, he has given many invited lectures in international conferences.

Publications shortlist

J. Y. Wang and Y. C. Zhou, "Recent progress in theoretical prediction, preparation, and characterization of layered ternary transition-metal carbides", Annu. Rev. Mater. Res. (2009)

J. Y. Wang, Y. C. Zhou, Z. J. Lin and T. Ohno, "Theoretical elastic stiffness of quaternary crystal Y3Si5N9O by first-principles investigation", Phys. Rev. B 77, No. 104117 (2008)

J. Y. Wang, Y. C. Zhou and J. Z. Lin "Mechanical properties and atomistic deformation mechanism of gamma-Y2Si2O7 from first-principles investigations" Acta Mater 55 6019 (2007)

J. Y. Wang, Y. C. Zhou, T. Liao and Z. J. Lin, "Trend in crystal structure of layered ternary T-Al-C carbides (T=Sc, Ti, V, Cr, Zr, Nb, Mo, Hf, W and Ta)" J. Mater. Res. 22 2685 (2007)

J. Y. Wang, Y. C. Zhou, T. Liao and Z. J. Lin, "First-principles prediction of low shear-strain resistance of Al3BC3: a metal borocarbide containing short linear C-B-C units", Appl. Phys. Lett. 89 021917 (2006)

Research field and interest

Multi-scale designing of high-performance structural/functional ceramics

Topic of speech in workshop

Design damage tolerant and “ductile” ceramics by nano-laminated integration inside unit cell

Abstract

High-temperature structural carbides and nitrides are typically brittle and sensitive to defects, which encumber their technological applications. Great efforts have been made in the last decades to overcome this serious problem. To toughen brittle ceramics, it was proposed to introduce microstructural heterogeneity in ceramic-matrix-composites. For instances, one can appropriate design of weak interfaces, large and elongate grains, and high internal stress in the ceramic microstructure. However, these efforts are very difficult to fully realized, because of difficulties in materials processing. Properties of synthesized composite depend on microstructure greatly, and also on the property-matching between different phases in ceramic-matrix-composites. The question is whether new family of high-temperature applicable carbides and nitrides could be developed with intrinsic “ductility” and damage tolerance. This presentation is to answer this curiosity.

Based on comprehensive first-principles investigations of relationships between chemical bonding, deformation mechanisms, and mechanical parameters of various ceramic systems, we established a general first-principles-based strategy to predict nano-laminated ceramics with intrinsic “ductility”. The theoretical criteria include bonding heterogeneity, low shear deformation resistance, and atomic scale load-bearing mechanism. Using the well-established theoretical method, new promising quasi-ductile ternary layered carbides and nitrides were successfully developed in our lab. We showed that damage tolerance and quasi-ductile can be succeeded by designing nano-laminated integration inside the unit cell of ternary carbides and nitrides.

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Deutschland und China –
Gemeinsam in Bewegung

DEUTSCH-CHINESISCHES
Jahr der Wissenschaft und Bildung
德中科学教育年
2009/10

Sino-German Joint Symposium on Advanced Materials and Technology

19/05/2009 – Tuesday

SESSION I (09:00-10:30)

Professor Hael MUGHRABI
  Topic: Cyclic Slip Irreversibilities and the Evolution of Fatigue Damage
Professor ZHANG Zhefeng
  Topic: Deformation mechanisms and mechanical properties of Cu and Cu-Al alloys subjected to equal channel angular pressing
Professor Oliver KRAFT
  Topic: Plasticity at Small Scales

SESSION II (10:50-11:50)

Professor HAN En-Hou
  Topic: Advanced Wrought Magnesium Alloy and Corrosion Protection Technologies
Professor Karl Ulrich KAINER
  Topic: Magnesium based implant materials

SESSION III (14:00-15:30)

Dr. Matthias OECHSNER
  Topic: Towards 2020 – Siemens' Perspective on Materials Needs for Advanced Gas Turbines of the Future
Professor ZHANG Jian
  Topic: Directional Solidification by Liquid Metal Cooling Process
Dr. JI Weiguo
  Topic: Potentials and Future Prospects of Compound Cast Back up Rolls in Medium Size

SESSION VI (15:50-17:10)

Professor LI Dianzhong
  Topic: Modelling and Experimental Activities for the Heavy Castings and Heavy Forgings: Some Experiencess
Professor HU Qingmiao
  Topic: First principles investigations of engineering alloys

德国
灵感与创新
Deutschland
Land der Ideen

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

MUGHRABI | **Hael**

Surname | Name

Professor
Dr. rer. nat.
Dr.-Ing. E.h., honorary doctoral degree from Ruhr-University Bochum.

Position(s) and academic title(s)

Friedrich-Alexander-Universität Erlangen

Research institution(s)

Short biography

After an apprenticeship at Robert Bosch GmbH company in Stuttgart, he studied physics at the Engineering University of Stuttgart. In his thesis work and as a senior researcher at the Max-Planck-Institute of Metal Research in Stuttgart (1966-1983), he specialized in metal physics and performed mainly research in the fields of mechanical properties and microstructural characterization. He was a Visiting Professor at Cornell University in 1978/79. In 1984, he joined the University of Erlangen-Nürnberg as a professor of Materials Science and Engineering and Head of an Institute of General Materials Properties. In subsequent years, he held positions as Department Head and Dean of the School of Engineering. Hael Mughrabi has published more than 290 papers and book chapters and has been editor/co-editor of several books/conference proceedings. He is the recipient of several awards. Since 2002, Hael Mughrabi is retired but still active in various forms in research and in committee work.

Publications shortlist

H. Mughrabi and F. Pschenitzka, “Stresses to bow edge dislocation segments out of di-multipolar edge dislocation bundles”, in: Proceedings of 14th International Conference on the Strength of Materials (ICSMA 14), Mater. Sci. Eng. A, 483-484. (2008) 469-473.

H. Mughrabi and H.W. Höppel: “Assessment of fatigue damage in heterogeneous materials by application of a novel compliance technique”, in “Multiscale Fatigue Crack Initiation and Propagation of Engineering Materials: Structural Integrity and Microstructural Worthiness”, edited by G.C. Sih, Springer Science + Business Media B.V., 2008, pp. 327-343.

A. Weidner, D. Amberger, F. Pyczak, B. Schönbauer, S. Stanzl-Tschegg and H. Mughrabi: „Fatigue damage in copper polycrystals subjected to ultrahigh-cycle fatigue below the PSB threshold”, Proc. of 17th European Conf. on Fracture (ECF 17), CD: ISBN: 978-80-214-3692-3, 2008.

H.W. Höppel, H. Mughrabi and A. Vinogradov: ”Fatigue Properties of Bulk Nanostructured Materials”, in “Bulk Nanostructured Materials”, Chapter 22, edited by M.J. Zehetbauer and Y.T. Zhu, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2009, pp. 481-500.

H. Mughrabi: “Microstructural aspects of high-temperature deformation of monocrystalline nickel-base superalloys: some open problems”, in Proceedings of The Malcolm McLean Memorial Symposium, edited by R. Reed and P. Lee, Special Issue of Mater. Sci. Technol. 25 (2009) 191-204.

Research field and interest

Microstructure and Mechanical Properties; Crystal Plasticity; Metal Fatigue; High-Temperature Mechanical Properties of Nickel-Base Superalloys;

Topic of speech in workshop

Cyclic Slip Irreversibilities and the Evolution of Fatigue Damage

Abstract

In this survey, the physical origin of fatigue crack initiation in ductile metals is discussed from a historical perspective. The main focus is to assess those cyclic slip irreversibilities in a microstructural sense that occur not only at the surface but also in the bulk at the dislocation scale and to show how they contribute to surface fatigue damage. The evolution of early fatigue damage, as evidenced experimentally in the last decades, is reviewed. The phenomenon of cyclic strain localization in persistent slip bands and models of the formation of extrusions, intrusions and microcracks are discussed in detail. The predictions of these models are compared with experimental evidence obtained on mono- and polycrystalline face-centred cubic (fcc) metals. In addition, examples of the evolution of fatigue damage in selected fcc solid solution alloys and precipitation-hardened alloys and in body-centred cubic (bcc) metals are analyzed. Where possible, the cyclic slip irreversibilities p, defined as the fraction of plastic shear strain that is microstructurally irreversible, have been estimated quantitatively. Broadly speaking, p has been found to vary over orders of magnitude ($0 < p < 1$), being almost negligible at low loading amplitudes (high fatigue lives) and substantial at larger loading amplitudes (low fatigue lives).

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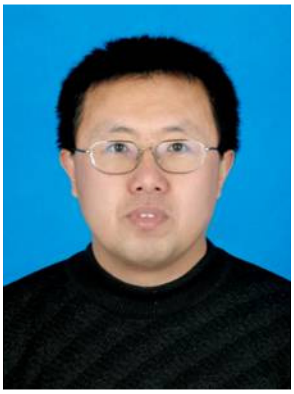

Personal information

张哲峰

Chinese name (汉字)

ZHANG Zhefeng

Western name or pinyin (surname, name)

Professor

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Zhe-Feng Zhang was born in 1970 and received his Ph. D at Institute of Metal Research (IMR) in June 1998, and became a full professor in January 2004. He has published more than 150 papers in international SCI journals, including Prog. Mater. Sci., Phys. Rev. Lett., Nature Mater., Acta Mater., Phys. Rev. B, Appl. Phys. Lett. etc. The above papers have been cited more than 1200 times by SCI papers. In June 2000, his Ph. D thesis was selected as "One of the National 100 Excellent Ph. D. Thesis". In 2004, his work on "Effects of Grain Boundaries and Crystallography on Cyclic Deformation and Fatigue Damage" was awarded by Natural Science Price from Liaoning Province. In 2006, he obtained the financial support of "National Outstanding Young Scientist Foundation Award" by National Science Foundation of Chins (NSFC), which is the greatest honor for young scientist in China.

Publications shortlist

Zhang, Z. F., and Wang, Z. G., Grain boundary effects on cyclic deformation and fatigue damage, Prog. Mater. Sci., 53 (2008) 1025-1099.

Zhang, Z. F., and Eckert, J., Unified tensile fracture criterion, Phys. Rev. Lett., 94 (2005) 094301.

Zhang, Z. F., He, G., Eckert, J., and Schultz, L., Fracture mechanisms in bulk metallic glassy materials, Phys. Rev. Lett., 91 (2003) 045505.

Zhang, Z. F., Eckert, J., and Schultz, L., Difference in compressive and tensile fracture mechanisms of Zr59Cu20Al10Ni8Ti3 bulk metallic glass, Acta Mater., 51 (2003) 1167-1179.

Zhang, Z. F., and Wang, Z. G., Dependence of intergranular fatigue cracking on the interactions of persistent slip bands with grain boundaries, Acta Mater., 51 (2003) 347-364.

Research field and interest

Mechanical properties of metallic materials, fundamental research on fatigue and fracture

Topic of speech in workshop

Deformation mechanisms and mechanical properties of Cu and Cu-Al alloys subjected to equal channel angular pressing

Abstract

The combined effects of crystallographic orientation, stacking fault energy (SFE) on deformation twinning behaviors in pure Cu subjected to one-pass equal channel angular pressing were investigated. It was found that profuse deformation twins were formed in pure Cu single crystals with special orientation even at room temperature and low strain rate. The current experimental results may provide some evidences that both SFE and crystallographic orientation have remarkable influence on the behaviors of deformation twinning in FCC crystals. Based on the experimental results above, ultrafine grained (UFG) or nanocrystalline (NC) Cu-Al alloys were prepared using ECAP technique to further investigate the influence of SFE on the microstructural evolution and the corresponding mechanical properties. The grain refinement mechanism was gradually transformed from dislocation subdivision to twin fragmentation with tailoring the SFE of Cu-Al alloys. Meanwhile, homogeneous microstructures and the nano-scale grains can be readily achieved in the low-SFE Cu-Al alloys and the equilibrium grain size decreased with lowering the SFE. In addition, the normalized deformation conditions at large strain were qualitatively discussed. More significantly, the strength and uniform elongation were simultaneously improved with lowering the SFE. This simultaneity results from the formation of profuse deformation twins, microscale shear bands, and their extensive intersections.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

KRAFT Surname

Oliver Name

Professor, Institute Director

Position(s) and academic title(s)

University of Karlsruhe and Forschungszentrum Karlsruhe

Research institution(s)

Short biography

Oliver Kraft graduated from the University of Stuttgart in 1995 in physical metallurgy. For his thesis, he received the Otto-Hahn-Medal of the Max-Planck-Society and the best thesis award of the "Freunde der Universität Stuttgart". From 1996 to 1997 he was a post-doc in the group of Prof. W.D. Nix in the Dept. of Materials Science and Engineering at Stanford University. From 1997 to 2002, he worked as a research scientist at the Max-Planck-Institut für Metallforschung in Stuttgart. Since 2002, Oliver Kraft is Professor for Reliability in Mechanical Engineering at the University of Karlsruhe and ly Director at the Institute for Materials Research at the Research Center Karlsruhe. He is speaker of a Collaborative Research Center on Micro-Molding at the Univeristy of Karlsruhe and chairman of the committee for Electronic Applications of Materials of the German Materials Research Society (DGM). Since 2008, he is elected referee for the DFG (German Science Foundation) in the area of materials science and engineering. He has authored or co-authored more than 150 publications and co-edited four books.

Publications shortlist

G.P. Zhang, C.A. Volkert, R. Schwaiger, E. Arzt, O. Kraft, Damage behavior of 200-nm thin copper films under cyclic loading, Journal of Materials Research 20, 201-207 (2005)

G.P. Zhang, C.A. Volkert, R. Schwaiger, P. Wellner, E. Arzt, O. Kraft, Length-scale-controlled fatigue mechanisms in thin copper films, Acta Materialia 54, 3127-39 (2006)

N. Huber, E. Tyulyukovskiy, O. Kraft, On the analysis of the stress-strain behavior of thin metal films on substrates using nanoindentation, Philosophical Magazine 86, 5505-5519 (2006)

C. Eberl, R. Spolenak, O. Kraft, F. Kubat, W. Ruile, E. Arzt, Damage analysis in Al thin films fatigued at ultrahigh frequencies, J. of Applied Physics 99, 113501-8 (2006)

J. Senger, D. Weygand, P. Gumbsch, O. Kraft, Discrete dislocation simulations of the plasticity of micro-pillars under uniaxial loading, Scripta Materialia 58, 587-590 (2008)

Research field and interest

Mechanical behavior of advanced structural materials, reliability of microelectronic and MEMS devices with focus on deformation and degradation mechanisms in thin films and small structures.

Topic of speech in workshop

Plasticity at Small Scales

Abstract

Since the 1950's, size effects on strength and deformation of metallic materials have been studied. Prominent effects that have been reported range from Hall-Petch behavior to the critical thickness theory for thin films to the indentation size effect. Most recently, unexpected size effects in micro-compression tests on sub-micron single-crystalline metallic pillars have drawn quite some attention, and have led to a debate about the underlying deformation mechanisms. However, preparation artifacts and testing geometry may contribute to some of the observations in an undesired manner. In the talk, recent results of micro-compression tests, including a comparison between fcc and bcc metals, will be presented and discussed in the light of discrete dislocation simulations.

Furthermore, we have made an effort in our work to conduct in situ tensile experiments on metallic nanowires in order to circumvent some of the experimental difficulties in the micro-compression tests. The tensile tests are conducted in a dual-beam scanning electron microscope and focused ion beam (SEM/FIB), where specimen manipulation, transfer, and alignment are performed using a manipulator and the FIB. Gripping of specimens is achieved using electron-beam assisted Pt deposition. Results shown will include tests on single-crystalline nanowires having diameters between 30 and 300 nm. Typically, fracture of the nanowires occurs locally without homogeneous ductile deformation. Measured strengths are of the order of the theoretical strength and show a weak size effect. The observed behavior will be discussed in the context of a statistical analysis with respect to the specimen size.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

韩恩厚

Chinese name (汉字)

HAN En-Hou

Western name or pinyin (surname, name)

Head of Division, Professor

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Prof. En-Hou Han received Ph.D. degree in 1990 from Northeastern University, and has three years work experience in Massachusetts Institute of Technology in USA as a research scientist during 1995-1998. Now he is Vice President of World Corrosion Organization, Vice President of Chinese Society for Corrosion and Protection. He also is the adjunct professor in Ohio State University in USA since 2004. He received the NACE Fellow in 2008. He is the chief scientist to be in charge of the largest national research project about corrosion of materials in China. As chairman or co-chairman, he organized 5 international conferences. He has published 3 books, more than 150 peer reviewed scientific papers and invented 30 patents. He also present more than 20 plenary and invited lectures in various international conferences.

Publications shortlist

D.K. Xu, L. Liu, Y.B. Xu, E.H. Han*, The fatigue behavior of I-phase containing as-cast Mg–Zn–Y–Zr alloy, Acta Materialia, 56 (2008) 985–994

D.K. Xu, L. Liu, Y.B. Xu and E.H. Han*, The relationship between macro-fracture modes and roles of different deformation mechanisms for the as-extruded Mg–Zn–Zr alloy, Scripta Materialia, 58 (2008) 1098–1101

R.F. Zhang, D.Y. Shan, R.S. Chen, E.H. Han*, Effects of electric parameters on properties of anodic coatings formed on magnesium alloys, Materials Chemistry and Physics, 107 (2008) 356–363

Hongwei Shi, Fuchun Liu, Lihong Yang, Enhou Han*, Characterization of protective performance of epoxy reinforced with nanometer-sized TiO2 and SiO2, Progress in Organic Coatings, 62 (2008) 359–368

Y.W. Song, D.Y. Shan, and E.H. Han*, Comparative study on corrosion protection properties of electroless Ni-P-ZrO2 and Ni-P coatings on AZ91D magnesium alloy, Materials and Corrosion, 58(2007), 506-510

Research field and interest

Corrosion and protection of metallurgical materials, Magnesium alloy, Corrosion resistance materials (weathering steel)

Topic of speech in workshop

Advanced Wrought Magnesium Alloy and Corrosion Protection Technologies

Abstract

Due to its many advantages, magnesium alloy become popular in last decade. However, there are some problems with the present wrought magnesium alloys, such as poor formability, lower room temperature strength and high temperature performances, especially poor corrosion properties, which limit their extensive applications.

The high strength wrought magnesium alloys were developed by rare earths addition with ultimate tensile strength, yield strength and elongation reaches to 428 MPa, 339 MPa and 4%. The materials processing techniques, properties characterization and mechanism were discussed.

Various corrosion protection methods were discussed such as chemical conversion coating, nano-self-assembling method, electroless nano-composite plating.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

KAINER — Surname

Karl Ulrich — Name

Director, Prof. Dr.

Position(s) and academic title(s)

Institute for Materials Research, GKSS Research Centre Geesthacht, Max-Planck-Str. 1, D-21502 Geesthacht, Germany

Research institution(s)

Short biography

Prof. Kainer studied at the University of Applied Science Osnabrueck and at the Clausthal University of Technology. He obtained his Ph.D degree in Materials Science at the Clausthal University of Technology in 1985 and his Habilitation in 1996. From 1985 to 1999 he was Head of the Light Metal, P/M and Composite Group at the Institute for Materials Science and Technology at Clausthal University of Technology. Since 1999 he is with the GKSS Research Centre and Professor on Materials Technology, Hamburg University of Technology. Prof. Kainer is Chairman of the Committee "Magnesium" of the German Society of Materials. He is member of the Board of Directors of International Magnesium Association and Chairman of the European Committee. He published 140 publications in JCR-listed journals, 400 publications in proceedings and non JCR listed journals. He gave 60 invited presentations. He has 18 pended or awarded patents. He is editor and co-editor of 12 books or proceedings.

Publications shortlist

Huang Y. D., Hort N., Dieringa H., Kainer K. U.,Liu Y. L.: Microstructural investigations near the interfaces in the short fiber reinforced AlSi12CuMgNi composites; Acta Mat. 53 14 (2005) 3913-3923.

Yi S.B., Davies C.H.J., Brokmeier H.-G., Bolmaro R.E., Kainer K.U., Homeyer J.: Deformation and texture evolution in AZ31 magnesium alloy during uniaxial loading; Acta Mat. 54 (2006) 549-562.

Winzer N., Atrens A., Dietzel W., Song G., Kainer K.U.: Comparison of the linearly increasing stress test and the constant extension rate test in the evaluation of transgranular stress corrosion cracking in magnesium; Mat. Sci. Eng. 472 1-2 (2007) 97-106.

Kozlov A., Ohno M., Abu Leil T., Hort N., Kainer K.U., Schmid-Fetzer R.: Phase equilibria, thermodynamics and solidification microstructures of Mg-Sn-Ca alloys, Part 2: Prediction of phase formation in Mg-rich Mg-Sn-Ca cast alloys; Intermetallics 16 (2008) 316-321.

Prasad, Y.V.R.K.; Rao, K.P.; Hort, N.; Kainer, K.U.: Optimum parameters and rate-controlling mechanisms for hot working of extruded Mg-3Sn-1Ca alloy; Materials Science and Engineering A. Vol. 502 (2009) 1-2, 25 - 31.

Research field and interest

Alloy and process development for magnesium alloys, metal matrix composites, metallic biomaterials

Topic of speech in workshop

Magnesium based implant materials

Abstract

Magnesium alloys have found vast applications in transportation and 3C industry. They offer a promising property profile for light weight constructions but still suffer from poor corrosion resistance. This obvious disadvantage of magnesium based materials can be turned into an advantage when these materials are used as biodegradable materials for medical implant applications. It would be possible to avoid a second time surgery when the implant would disappear after fulfilling its service. Magnesium itself can be desorbed easily and is essential for the human body. Together with a property profile that is close to human bone this makes magnesium a perfect biodegradable implant material. This contribution will give an overview on the property profile and the processing of magnesium based materials which are potential candidates for degradable implant materials in musculoskeletal and cardiovascular applications.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

OECHSNER — Surname

Matthias — Name

General Manager, Dr. Ing.

Position(s) and academic title(s)

Siemens Gas Turbine Parts Ltd., Shanghai, China

Research institution(s)

Short biography

Received Diploma in Mechanical Engineering in 1995 and Dr. Ing. in 2000 - both at Karlsruhe University, Germany.

1997 – 1999: Siemens Corporate Technology in Munich: Reliability analysis and Life time prediction
1999 – 2001: Siemens Westinghouse Power Generation, Orlando, Florida: Project lead Life Time Modelling and Reliability Analysis of Thermal Barrier Coating Systems
2001 – 2005: Siemens Power Generation, Muelheim, Germany: Head of global Gas Turbine Materials Development
2005 – 2006: Siemens Power Generation, Muelheim, Germany: Head Turbine Engineering Mülheim
2006 - 2008: Siemens Power Generation: Director global Gas Turbine Materials and Technology
since 2008: General Manager Siemens Gas Turbine Parts Ltd. Shanghai, China

Research field and interest

Gas Turbine Materials

Topic of speech in workshop

Towards 2020 – Siemens' Perspective on Materials Needs for Advanced Gas Turbines of the Future

Abstract

With approx. 40% of all Power Generation provided through Industrial Gas Turbines - either in single cycle application or in combination with Steam Turbines in a combined cycle arrangement - Gas Turbines are a major contributor in covering today's world energy demand.
While the global demand for Energy is expected to grow with > 3.7% or ~ 570 TWh per year, the demand for gas fired power generation is expected to grow to almost 1600 GW capacity by 2015 and to about 2000 GW by 2020. This increased market demand will result in continued emphasis on increased performance and reliability while simultaneously providing a cost effective, efficient, and environmentally sound power generation solution.

In order to push the capability of gas turbine engines for higher efficiency and power generation capacity further, advances in material and coating systems will play a pivotal role. While in the past, large industrial gas turbines "simply" adopted many of the advances in materials technology developed by the aero turbine community, the limitations of that traditional approach become more and more obvious. Manufacture-ability aspects, fuel flexibility, and life time requirements, as examples, provide challenges unique to large industrial gas turbines. As a consequence, a paradigm change in materials system development and utilization for large engines is required and a dedicated development approach for large Gas Turbines is needed.

The presentation will provide an overview on the status of Materials Systems applications in Gas Turbines for Power Generation and will discuss the development challenges to meet the need of advanced Gas Turbines for the future.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

张健

Chinese name (汉字)

ZHANG Jian

Western name or pinyin (surname, name)

Professor

Position(s) and academic title(s)

Institute of Metal Research, Chinese Academy of Sciences

Research institution(s)

Short biography

Dr. Jian Zhang studied at Institute of Metal Research, Chinese Academy of Sciences from 1996 to 1999. During this period, from 1998 to 1999, he worked at MSE Department, Brunel University in England as a co-supervised PhD student. He received his PhD degree in 1999, and returned to Brunel Univeristy in the same year. After a year of postdoctoral study in England, he joined Institute of Science and Technology of Metals at University of Erlangen-Nuremberg in Germany. He was selected by "Outstanding oversea talents" program of Chinese Academy of Sciences in 2002, and became a Professor at Superalloys Division, Institute of Metal Research, Chinese Academy of Sciences in 2003.

Publications shortlist

Effect of heat treatment atmosphere on surface recrystallization of a directionally solidified Ni-base superalloy, G. Xie, J. Zhang, L. H. Lou, Scripta Mater., 59 (2008) 858-861.

Effect of boron additions on the microstructure and transverse properties of a directionally solidified superalloy, B. C. Yan, J. Zhang, L. H. Lou, Mater. Sci. Eng. A, 474 (2008) 39-47.

Influence of surface recrystallization on the high temperature properties of a directionally solidified Ni-Base superalloy, G. Xie, L. Wang, J. Zhang, L. H. Lou, Metall. Mater. Trans. A, 39 (2008) 206-210.

Directional solidification assisted by liquid metal cooling, J. Zhang, L. H. Lou, J. Mater. Sci. Technol., 23 (2007) 289-300.

Effect of Zr and B on castability of Ni based superalloy IN792, J. Zhang, R. Singer, Metall. Mater. Trans. A, 35 (2004) 1337-1342.

Research field and interest

Directional solidified and single crystal superalloys: alloy and processing development; defect control; mechnical properties;

Topic of speech in workshop

Directional Solidification by Liquid Metal Cooling Process

Abstract

Recent progress of high gradient directional solidification assisted by the liquid metal coolant (Sn) was reported. Microstructure, heat treatment response and mechanical properties of large castings with maximum length of 300mm obtained by high rate solidification (HRS) and liquid metal cooling (LMC) techniques were compared. Microstructure and mechanical properties of alloys with deliberately added Sn were also studied. Comparing to HRS casting, mechanical properties of the LMC casting were slightly increased, but with a much smaller scattering. The key challenges of LMC process, namely, the contamination of low melting metal coolant, and ceramic core and shell issue were discussed based on the experimental results.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

JI | **Weiguo**

Surname | Name

Product Development & Area Sales Manager Asia, Dr.-Ing.

Position(s) and academic title(s)

Gontermann-Peipers GmbH
57074 Siegen

Research institution(s)

Short biography

1960 Birth in Shanghai.
Oct. 1980 - May 1985. Study in RWTH Aachen, Material Science
May 1980 - Sept. 1989. PhD in Institute of Metal Forming, RWTH Aachen
Since Oct. 1989 employee by Rollmaker Gontermann-Peiper GmbH, responsible for Product development and Sales in Asia Area

Publications shortlist

China International Steel Mill rolls conference 2008, June 2. – 4. Shanghai, China
“Safe Production of rolls of Semi-HSS Quality for Hot rolling mills and their rational application
JSW – Rolls´07, India
International Workshop on rolls for flat rolling of Steel, Feb. 26 – 27. 2007
“Choice of roll qualities in modern hot strip mills”
Materials Science & Technology 2005, Sept. 25 – 28, 2005, Pittsburgh, USA
“Influence of roll profiles on linear load distribution and barrel edge damages of backup rolls”
POSCO Roll Workshop, Sept. 2004, Kwangyang, South Korea
“Choice of roll grades in european Hot Strip – and Heavy Plate mills”
Asia Steel 2003, April 2003 in Jemsedpur, India
“HSS-Work rolls for roughing stands in HSM and the first stands of CSP mills”

Research field and interest

Backup Roll and Work Roll for Rolling mill in Steel Industry

Topic of speech in workshop

Potentials and Future Prospects of Compound Cast Back up Rolls in Medium Size

Abstract

Rolls are indispensible in Steel industry. With increasing production in China the consumption of rolls, too, is growing. China uses roughly 500.000 tons of rolls per year.

Back up rolls in mills producing flat steel have the function to increase the rigidity of the stand and to relieve the work rolls. The load, also wear and long times per run are very rough on these rolls. Newly constructed, modern mills are even increasing the load. Traditionally, Back up rolls are produced as cast and forged rolls. Gontermann-Peipers GmbH produces compound cast rolls since nearly 60 years with a shell of highly alloyed, wear resistant material and a core of low alloyed, tenacious material.

In order to counteract the load in rolling process, the back up rolls have to present certain characteristics. Further development of material, with regard to material as well as technology, are permanently accompanied by co-operation with universities and research institutes

The present paper shows furthermore that compound cast rolls offer a lot of flexibility due to the option to choose the roll material and also have advantages in the roll production. Therefore this philosophy is going to be pursued in the future as well.

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

李殿中 — Chinese name (汉字)

LI Dianzhong — Western name or pinyin (surname, name)

Division Head of Materials Process Modelling Division, SYNL, Professor

Position(s) and academic title(s)

Materials Process Modelling Division, SYNL, Institute of Metal Research,CAS

Research institution(s)

Short biography

Li Dianzhong was born in Xingcheng city, Liaoning Province in May 1966. He graduated from Harbin Institute of Technology (HIT) in 1989, and completed his graduate study in Shenyang Research Institute of Foundry in 1992, and then worked at the institute until 1997. In 1998, he received his Ph. D. degree from HIT and was selected as a professor of "Hundred Talents Program" of Chinese Academy of Sciences (CAS), being a group leader and Ph. D. supervisor to establish the modeling of materials processing group in Institute of Metal Research (IMR). As a visiting professor Sponsored by Royal Society K.C. Wong Fellowships, he collaborated with John Campbell, a member of Royal Engineering Society, to develop simulation of castings and design for advanced material processing in Birmingham University in 2001.Now he is division head of Materials Process Modelling.

Publications shortlist

D.Z. Li, N.M. Xiao,Y.J. Lan, C.W. Zheng and Y.Y. Li. Growth modes of individual ferrite grains in the austenite to ferrite transformation of low carbon steels. Acta Mater, 55, 2007, 6234-6249

N. M. Xiao, M. M. Tong, Y. J. Lan, D. Z. Li and Y. Y. Li: Coupled simulation of the influence of austenite deformation on the subsequent isothermal austenite–ferrite transformation. Acta Mater, 54, 2006, 1265-1278.

Y.J. Lan, N.M. Xiao, D.Z. Li and Y.Y. Li: Mesoscale simulation of deformed austenite decomposition into ferrite by coupling a cellular automaton method with a crystal plasticity finite element model. Acta Mater, 53, 2005, 991-1003.

Y. J. Lan, D. Z. Li and Y. Y. Li: Modeling austenite decomposition into ferrite at different cooling rate in low-carbon steel with cellular automaton method. Acta Mater, 52, 2004, 1721-1729.

Tong MM, Li DZ and Li YY. A q-state Potts model-based Monte Carlo method used to model the isothermal austenite-ferrite transformation under non-equilibrium interface condition. Acta Mater, 53, 2005, 1485-1497.

Research field and interest

- Process Modelling
- Phase Transformation Modelling
- Heavy Castings and Forgings

Topic of speech in workshop

Modelling and Experimental Activities for the Heavy Castings and Heavy Forgings: Some Experiencess

Abstract

The manufacture business has been facing tremendous pressures to bring its products to domestic market more quickly and at lower cost. Around the world, numerical modelling is seen as a beneficial activity which can help in this regard. But what are its advantages and limitations? How to use and validate it in the heavy castings and heavy forgings? In this seminar, the presenter will discuss his experiences with the use of numerical modelling for the design of heavy castings and heavy forgings. Modelling is possible at different lengthscales: (i) at the component lengthscale, e.g. for the simulation of the casting of huge stainless steel castings or for the forging of crankshaft and huge ingots (ii) at the microstructural scale, to elucidate the phase transformation mechanisms occurring on the meso-scale of the austenite ferrite transformation in the steels. Some case studies will be presented and then some overall conclusions will be drawn.f

Notes

Sino-German Joint Symposium on Advanced Materials and Technology

Personal information

胡青苗

Chinese name (汉字)

HU Qing-Miao

Western name or pinyin (surname, name)

Ph. D.

Position(s) and academic title(s)

Institute of Metal Research, Chinease Academy of Sciences

Research institution(s)

Short biography

October 20, 1971, Born in Anhui, China
Sep 1989~Jul 1993, B. S., Metals Physics, Northeastern University, Shenyang, China;
Jul 1993~Sep 1995, Assistant Engineer, Maanshan & Magang Heli Co Ltd, Maanshan, Maanshan, China;
Sep 1995~Mar 1998, M. S., Materials Physics, Northeastern University, Shenyang, China;
Mar 1998~Nov 2001, Ph. D., Materials Physics, Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China;
Nov 2001~May 2003, Post-doctoral Research Fellow, Institute of Metal Research, Chinese Academy of Sciences, Shenyang China;
Sep 2003~Sep 2005, Humboldt Research Fellow and Post-doctoral Research Fellow, Fritz-Haber Institute, Max-Planck Society, Berlin, Germany;
Sep 2006~Aug. 2007, Mar 2008~July 2008, Dec 2008~Jan 2009, Visiting Scientist, Department of Materials Science and Engineering, Royal Institute of Technology, Stockholm, Sweden;
July 2003~present, Associate Professor, Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China.

Publications shortlist

Phase stability and elastic modulus of Ti alloys containing Nb, Zr, and/or Sn from first principles calculations, Q.M. Hu, S.J. Li, Y.L. Hao, R. Yang, B. Johansson, L. Vitos, Appl. Phys. Lett. 2008; 93: 121902.

Predicting hardness of covalent/ionic solid solutions from first-principles theory, Q.M. Hu, K. Kadas, S. Hogmark, R. Yang, B. Johansson, L. Vitos, Appl. Phys. Lett. 2007; 91: 121918.

Towards an exact treatment of exchange and correlation in materials: Application to the "CO adsorption puzzle" and other systems, Qing-Miao Hu, Karsten Reuter, and Matthias Scheffler, Phys. Rev. Lett. 2007; 98: 176103. Highlighted by Science 2007; 316: 662.

Concentrated point defects in and order-disorder transition temperature of intermetallic compounds, Q.M. Hu, R. Yang, Y.L. Hao, D.S. Xu, D. Li, Phys. Rev. Lett. 2004; 92: 185505.

Energetics and electronic structure of a grain boundary and surface of B and/or H doped Ni_3Al, Q. M. Hu, R. Yang, D. S. Xu, D. Li, and W. T. Wu, Phys. Rev. B 2003; 67: 224203.

Research field and interest

I'm working in the field of computer aided design of engineering alloys. My research interests are mainly focused on the theoretical modeling of mechanical and thermo-dynamical properties of metals and alloys by the use of first-principles methods such as EMTO-CPA, FPAPW (Wien2K), PP-PW (VASP, CASTEP, etc.).

Topic of speech in workshop

First principles investigations of engineering alloys

Abstract

First principles method based on electronic structure theory is one of the most promising approaches of computational materials design. Nevertheless, the application of first-principles method on engineering alloys has been greatly limited since most real engineering alloys are random solid solutions, whereas first-principles method, in principle, applies only to the system with ordered structure. In recent years, the implementation of the coherent potential approximation (CPA) in the self-consistent field (SCF) calculation with exact muffin-tin orbital (EMTO) and full charge density (FCD) technique makes it possible to calculate accurately the random alloys directly by the use of first-principles method. The EMTO-CPA method has been applied successfully on many disordered systems. In this presentation, I will report our EMTO-CPA investigations of the alloying effects on (a) the phase stability and elastic modulus of beta-titanium alloys; (b) the elastic modulus of TiNi based shape memory alloys; and (c) the hardness of transition metal carbide and nitride. It will be shown that the obtained results are helpful to the rational design of these engineering important materials.

Notes

Institute of Metal Research
Chinese Academy of Sciences

Director: Prof. LU Ke
Address: 72 Wenhua Road, Shenyang 110016, P.R. China
Phone: 86-24-2397 1500
Fax: 86-24-2389 1320
E-mail: zzhao@imr.ac.cn
Website: http://www.imr.ac.cn

The Institute of Metal Research (IMR), Chinese Academy of Sciences (CAS) was founded in 1953, and the first–term Director was Prof. Hsun Lee. The new IMR was formed in 1999 by merging with the former Institute of Corrosion and Protection of Metals (ICPM) of the Chinese Academy of Sciences which was established in 1982. The IMR is now one of the most important R & D base for materials science and engineering in China.

The IMR is mainly engaged in research and development of high performance metallic materials, new inorganic nonmetallic materials and advanced composite materials covering their structures, properties, performances, corrosion and protection, as well as the relationship among them. IMR pays equal attention to materials engineering such as synthesis, fabrication, processing and applications.

Presently IMR has one national laboratory, one state key laboratory, sixteen research divisions, two national engineering research centers and several spin-off high-tech enterprises. These include the Shenyang National Laboratory for Materials Science (SYNL, ten research divisions), the State Key Laboratory for Corrosion and Protection, the Shenyang Research and Development Center for Advanced Materials (seven research divisions), the Research Center for Environmental Corrosion of Materials, the National Engineering Research Center for Homogenized Alloys, the National Engineering Technology Center for Corrosion Control, and Shenyang Kejin New Materials Corporation, Ltd.

In recent years, IMR has made great achievements in the field of materials physics, non-equilibrium materials and nano-materials, machinable advanced ceramics, special materials for crucial environment, high temperature titanium alloys, superalloys, SiC foams, energy materials, computer simulations, materials processing and materials protection techniques. 1989 articles were published in international journals and 495 patents were obtained within last four years.

IMR currently has a staff of 834, including 8 CAS and CAE Members, 101 Professors, 93 Associate Professors and 76 Senior Engineers. In addition, there are 342 graduate students pursuing for Ph. D and 233 for Master degree, 30 postdoctoral fellows and 40 visiting scientists at IMR.

IMR has close relationships with institutions, universities and academic associations from more than 30 countries and regions to carry out scientific exchanges and co-operations. There are 18 scientists holding positions in 49 international academic organizations or journals.

IMR edits and publishes six key academic periodicals, including Acta Metallurgica Sinica, Journal of Materials Science & Technology, Chinese Journal of Materials Research, Journal of Chinese Society for Corrosion and Protection.

Finally, the mission of IMR is to excel in materials research, develop advanced materials technology and foster exceptional talents, serving the nation, the society and mankind.

Contacts of Participants

CHAIR OF SYMPOSIUM

Prof. LU Ke
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1508
Fax: +86 24-2398 1320
E-mail: lu@imr.ac.cn

Prof. Manfred RUEHLE
Max Planck Institute for Metals Research
Address: Heisenbergstr. 3
70569 Stuttgart, Germany
Phone: +49 711-689 3520,
Fax: +49 711-689 3653
E-mail: ruehle@mf.mpg.de

ORGANIZERS

Ms. ZHAO Zhe
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1500
Fax: +86 24-2389 1320
E-mail: zzhao@imr.ac.cn

Prof. ZHANG Zhefeng
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1043
Fax:+86 24-2389 1320
E-mail: zhfzhang@imr.ac.cn

Mr. JIANG Jun
Shenyang Municipal Government
International Cooperation Department of
Shenyang Science and Technology Bureau
Address: 260 Shifu Road, Shenhe District,
Shenyang 110013, P.R. China
Phone: +86 24-2272 1526
Fax: +86 24-2272 1432
E-mail: jj@systi.net.cn

Mr. Josef GOLDBERGER
Germany and China – Moving ahead togethter
Team Education and Science
Address: Zhongshan Park, Sun Zhongshan Memorial Building
7 Nanjing South Street, Heping District,
Shenyang 110001, P.R. China
Phone: +86 24-2322 2021
Fax: +86 24-2322 2190
E-mail: josef_gold@hotmail.com

OPENING SPEECHES

Prof. LU Ke
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Director
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1508
Fax: +86 24-2398 1320
E-mail: lu@imr.ac.cn

Dr. Matthias HACK
Embassy of the Federal Republic of Germany (Beijiing)
First Counsellor Science and Technology
Address: 17 Dongzhimenwai Dajie, Chaoyang District,
Beijing 100600, P.R. China
Phone: +86 10-8532 9307
Fax: +86 10-6532 5335
E-mail: wiss-1@peki.diplo.de

Mr. Stefan HASE-BERGEN
German Academic Exchange Service (Beijing)
Director
Address: Unit 1718, Landmark Tower 2
8 North Dongsanhuan Road, Chaoyang District
Beijing 100004, P.R. China
Phone: +86 10-6590 6656
Fax: +86 10-6590 6393
E-mail: director@daad.org.cn

CONTACTS OF SPEAKERS

Prof. DU Kui
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-8397 0725
Fax: +86 24-2389 1320
E-mail: kuidu@imr.ac.cn

Prof. Michael GIERSIG
Freie Universitaet Berlin, Department Physics
Institute for Experimental Physics
Address: Arnimallee 14,
14194 Berlin, Germany
Phone: +49 30-838 56095
Fax: +49 30-838 56299
E-mail: giersig@helmholtz-berlin.de

Prof. HAN Enhou
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2391 5772
Fax:+86 24-2389 4149
E-mail: ehhan@imr.ac.cn

Dr. Dirk HOLLAND-MORITZ
Institute of Materials Physics in Space, German Aerospace Center (DLR)
in the Helmholtz Association
Address: Linder Hoehe
51147 Koeln, Germany
Phone: +49 220-3601 3292
Fax: +49 220-3601 2255
E-mail: dirk.holland-moritz@dlr.de

Prof. HU Qingmiao
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1813
Fax: +86 24-2398 1320
E-mail: qmhu@imr.ac.cn

Dr. JI Weiguo
Gontermann-Peipers GmbH
Address: Hauptstrasse 20
57074 Siegen, Germany
Phone: +49 271-60 231
Fax: +49 271-60 5231
E-mail: Wji@gontermann-peipers.de

Prof. Karl Ulrich KAINER
GKSS Research Centre, Institute of Materials Research
Magnesium Innovation Centre
Address: Max-Planck-Str.
21502 Geesthacht, Germany
Phone: +49 4152 8725 90
Fax: +49 4152 8726 36
E-mail: karl.kainer@gkss.de

Prof. Oliver KRAFT
Institute of Materials Research (IMF II) and
Institute for Reliability of Components and Systems (IZBS), University of Karlsruhe
Address: Postfach 3640,
76021 Karlsruhe, Germany
Phone: +49 7247 82 4815
Fax: +49 7247 82 5859
E-mail: oliver.kraft@imf.fzk.de

Prof. LI Dianzhong
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1281
Fax: +86 24-2389 1320
E-mail: dzli@imr.ac.cn

Prof. LU Lei
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1939
Fax: +86 24-2389 1320
E-mail: llu@imr.ac.cn

Prof. Haël MUGHRABI
University of Erlangen-Nuernberg
Department Werkstoffwissenschaften
Address: Martensstraße 5
91058 Erlangen, Germany
Phone: +49 9131 8527482
Fax: +49 9131 8527504
E-Mail: mughrabi@ww.uni-erlangen.de

Prof. Klaus G. NICKEL
Eberhard-Karls-University Tuebingen
Faculty for Geosciences, Applied Mineralogy
Address: Wilhelmstr. 56
72074 Tuebingen, Germany
Phone: +49 7071-2976 802
Fax: +49 7071-2930 60
E-mail: klaus.nickel@uni-tuebingen.de

Dr. Matthias OECHSNER
SIEMENS Gas Turbine Parts Ltd.
Address: No.48 Lan Ping Road, Min Hang
Shanghai 200240, P.R. China
Phone: +86 21-6115 3001
Fax: +86 21-6115 3100
E-mail: matthias.oechsner@siemens.com

Prof. Manfred RUEHLE
Max Planck Institute for Metals Research
Address: Heisenbergstr. 3
70569 Stuttgart, Germany
Phone: +49 711-689 3520,
Fax: +49 711-689 3653
E-mail: ruehle@mf.mpg.de

Prof. Jochen SCHNEIDER
Materials Chemistry, RWTH Aachen University,
Address: Mies-van-der-Rohe-Strasse 10
52074 Aachen, Germany
Phone: +49 241-802 5966
Fax: +49 241-802 2295
E-mail: schneider@mch.rwth-aachen.de

Prof. WANG Jingyang
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1762
Fax: +86 24-2389 1320
E-mail: jywang@imr.ac.cn

Prof. XU Jian
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1950
Fax: +86 24-2389 1320
E-mail: jianxu@imr.ac.cn

Prof. ZHANG Guangping
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1938
Fax: +86 24-2389 1320
E-mail: gpzhang@imr.ac.cn

Prof. ZHANG Jian
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1196
Fax: +86 24-2389 1320
E-mail: jianzhang@imr.ac.cn

Prof. ZHANG Zhefeng
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1043
Fax: +86 24-2389 1320
E-mail: zhfzhang@imr.ac.cn

Prof. ZHOU Yanchun
Shenyang National Laboratory for Materials Science
Institute of Metal Research, CAS
Address: 72 Wenhua Road,
Shenyang 110016, P.R. China
Phone: +86 24-2397 1765
Fax: +86 24-2389 1320
E-mail: yczhou@imr.ac.cn