



*The 16th International Conference on  
Rapidly Quenched & Metastable Materials*

*27. August to 1. September 2017, Leoben, Austria*

*PROGRAMME*



## Preface RQ16

The 16th International Conference on Rapidly Quenched and Metastable Materials (RQ16) will take place in Leoben, Austria from the 28<sup>th</sup> August to 1<sup>st</sup> September 2017. This triennial series of RQ meetings has a long tradition, starting in 1970 – Brela, 1975 – Boston, 1978 – Brighton, 1981 – Sendai, 1984 – Würzburg, 1987 – Montreal, 1990 – Stockholm, 1993 – Sendai, 1996 – Bratislava, 1999 – Bangalore, 2002 – Oxford, 2005 – Jeju Island, 2008 – Dresden, 2011 – Salvador, 2014 – Shanghai, 2017 – Leoben. Leoben itself has long history in metal processing ranging from iron extraction to the establishment of an added manufacturing laboratory. The town hosts next to the Montanuniversität centres of excellence in materials, material physics, foundry technology and polymers as well as a steel works producing the longest rails exposed to severe plastic deformation.

Over the long history of the RQ meetings scientific interest moved from extended solubilities to metallic glasses, their processing, structure and properties, to bulk metallic glasses and metastable materials obtained by severe plastic deformation, high entropy alloys to name not all of the topics covered by the conference series. The demand for new materials with unique mechanical, chemical and physical properties stimulates ongoing research on rapidly quenched and metastable materials. With the arrival of added manufacturing techniques, powder processing and rapidly (re-) quenched microstructures and their properties have found a place at RQ16.

These topics cover exiting developments from the traditional field of rapidly quenched metals to established areas such as bulk metallic glasses and nanostructured materials and newly emerging technologies as in added manufacturing and high entropy alloys. As such, the topics covered in the abstracts promise to show the most recent experimental and theoretical achievements in the fields of metastable materials, quasicrystals, nanometer-scale materials, magnetic materials, metallic glasses, solid state reaction, undercooling and modelling.

The RQ16 conference attracted a total of 202 abstracts submitted by scientists from 24 different countries. The conference included 14 plenary talks 19 invited keynote talks and 45 invited talks. In addition, 84 regular oral contributions were presented and more than 40 posters were presented. The RQ distinguished Fellowship Award for pioneering research on rapidly quenched and metastable materials and outstanding contributions to the expansion of the RQ community will be presented to distinguished persons.

It is our pleasure to thank the members of the International Advisory Committee for their valuable help, especially for proposals for plenary and keynote speakers. We acknowledge particularly support from the Bürgermeister in Leoben (DFG) and the Montanuniversität in Leoben and we are grateful for industrial support from Zoz Group, Edmund Bühler and Mettler-Toledo.

Finally, we wish all participants to have an enjoyable and successful meeting.

Peter Schumacher, Jürgen Eckert and Jörg Löffler

## **International Scientific Committee**

Livio Battezzati  
Walter Jose Botta  
Brian Cantor  
K. Chattopadhyay  
Jürgen Eckert  
Hans J. Fecht  
A. Lindsay Greer  
Akihisa Inoue  
Keiichi N. Ishihara  
Jianzhong Jiang  
Ken Kelton  
DoHyang Kim

Won Tae Kim  
Tadeusz Kulik  
Enrique J. Lavernia  
Elena Levchenko  
Yi Li  
Ke Lu  
Akihiro Makino  
B.S. Murty  
Ludwig Schultz  
Peter Svec  
Weihua Wang  
Deliang Zhang

## **Local Organisation Committee**

Bruno Buchmayr  
Helmut Clemens  
Robert Danzer  
Jozef Keckes  
Prashanth Konda Gokuldoss  
Jiehua Li  
Christian Mitterer  
Reinhard Pippan  
Florian Spieckermann

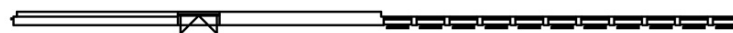
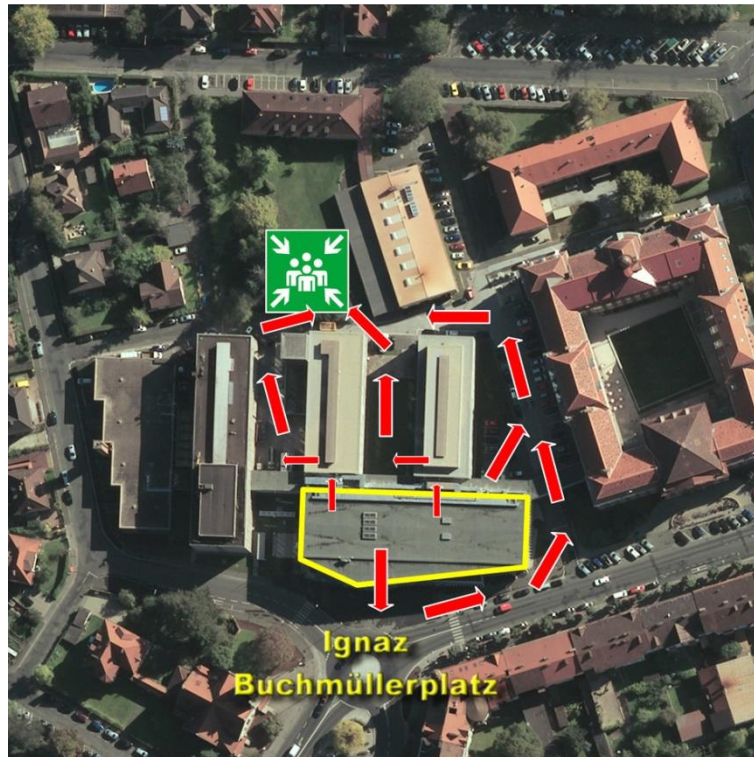
## **Chairmen**

Peter Schumacher  
Jörg Löffler  
Jürgen Eckert

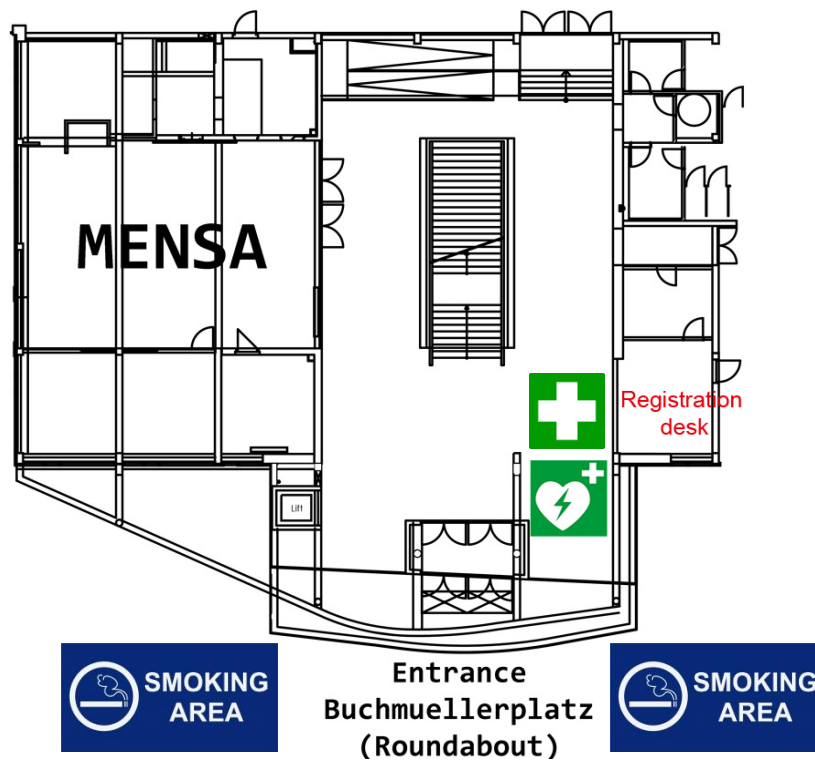
## **Secretary**

Tanja Moser  
  
Jiehua Li

# Safety instructions



Connecting corridor



Please leave the building before 20:30.

Monday, 28 <sup>th</sup> August			
8:00	Registration		
10:00	Opening ceremony Plenary Lecture Hall, Chairman: Peter Schumacher		
	Plenary Session I	Chairman: Jürgen Eckert	
10:30	Multicomponent and high entropy alloy Prof. Brian Cantor (University of Bradford, UK)		
11:10	An inside look at the deformation of a simple glass using colloids Prof. Frans Spaepen (Harvard University, USA)		
11:50	Primary crystallization of Al nanocrystals in a Al <sub>88</sub> Y <sub>7</sub> Fe <sub>5</sub> metallic glass: thermodynamic and kinetic analyses Prof. John Perepezko (University of Wisconsin-Madison, USA)		
12:30	Lunch and lunch break		
	Room A	Room B	Room C
	A1-Metallic glasses 1: Deformation Chairman: <u>Ralf Busch</u>	B1-Additive manufacturing & powder metallurgy Chairman: <u>Bruno Buchmayr</u>	C1-Nanostructured materials 1 Chairman: <u>Jayanta Das</u>
14:00	<b>Keynote Lecture:</b> Metal-like ductile fracture of metallic glasses at room temperature <u>Y. Li</u> (Institute of Metal Research, Chinese Academy of Sciences, China)	<b>Keynote Lecture:</b> Rapid solidification of Al-Si alloys: a comparison with additive manufacturing (AM) <u>Livio Battezzati</u> (Università di Torino, Italy)	<b>Keynote Lecture:</b> Towards thermally stable nanocrystalline alloys with exceptional strength: Cu-Cr as a case study <u>Gerhard Dehm</u> (Max-Planck-Institut für Eisenforschung GmbH, Germany)
14:30	<b>Invited Lecture:</b> Rethinking atomic packing and cluster formation in metallic liquids and glasses <u>Mo Li</u> (Georgia Institute of Technology, USA)	<b>Keynote Lecture:</b> Structure-property correlations in 3D printed metals <u>U. Ramamurty</u> (Indian Institute of Science, India)	<b>Invited Lecture:</b> Abnormal coarsening of a nanoscale microstructure goes fractal <u>Carl E. Krill III</u> (Ulm University, Germany)
15:00	Low-cost Fe-based bulk metallic glasses with good glass forming ability. <u>Alberto Moreira Jorge Jr.</u> (Federal University of São Carlos, Brazil)	Mechanically milled and spark plasma sintered pure copper <u>Masahiro Kubota</u> (Nihon University, Japan)	Deformation mechanisms to ameliorate the mechanical properties of Co-Cr-Mo-(Cu) ultrafine eutectic alloys <u>Jeong Tae Kim</u> (Erich Schmid Institute of Materials Science, Austria)
15:15	Delocalized plastic flow in proton-irradiated monolithic metallic glasses <u>Dongchan Jang</u> (Korea Advanced Institute of Science and Technology, South Korea)	Effect of scan strategy and annealing on microstructure and properties of 316L stainless steel synthesized by selective laser melting <u>O.O. Salman</u> (IFW Dresden, Germany)	Delocalization of stress/strain partitioning between amorphous matrix and 2 <sup>nd</sup> phase in a TRIP bulk metallic glass composite <u>Hyun Seok Oh</u> (Seoul National University, Republic of Korea)
15:30	Strain dependence of diffusion in Zr-based bulk amorphous alloy <u>Min-Ha Lee</u> (Korea Institute of Industrial Technology, South Korea)		Local investigation of superelastic behavior of titanium alloys during nanoindentation <u>Amélie Fillon</u> (INSA Rennes, France)

15:50	Coffee break		
	A2- Rapid solidification & high undercooling Chairman: <u>John Perepezko</u>	B2- Metallic glasses 2: Properties & application Chairman: <u>Y. Li</u>	C2- Severe plastic deformation 1 Chairman: <u>A. L. Greer</u>
16:10	<b>Keynote Lecture:</b> The structure-dynamics relationship in binary glass-forming alloy melts <u>Dirk Holland-Moritz</u> (DLR, Institute of Materials Physics in Space, Germany)	<b>Keynote Lecture:</b> Superelasticity of Ni-Ti-Cu-Zr alloy with high glass forming ability <u>D.H. Kim</u> (Yonsei University, South Korea)	<b>Keynote Lecture:</b> Excess volume and defect annealing in ultrafine-grained Ni studied by difference dilatometry and neutron diffraction <u>Roland Würschum</u> (Graz University of Technology, Austria)
16:40	<b>Invited Lecture:</b> Classical nucleation theory analysis of priming in fast crystallizing chalcogenide phase-change memory <u>Jiri Orava</u> (University of Cambridge, UK)	<b>Invited Lecture:</b> Multiple relaxation pathways and polyamorphism in a Au-based bulk metallic glass <u>Isabella Gallino</u> (Saarland University, Germany)	<b>Invited Lecture:</b> SPD as a tool to improve physical properties of functional materials <u>M.J. Zehetbauer</u> (Univ. Vienna, Austria)
17:05	<b>Invited Lecture:</b> High-temp. & corrosion-resistant/irradiation-tolerant ODS/NFA-steels/powder from the shelf Henning Zoz (Zoz Group, Germany)	<b>Invited Lecture:</b> Rapidly quenched Fe-based glassy alloys with low Curie temperature for medical and engineering applications <u>Nicoleta Lupu</u> (National Institute of Research and Development for Technical Physics, Romania)	<b>Invited Lecture:</b> Partitioning and segregation of elements during non-equilibrium processing of an Al-Fe alloy <u>Gang Sha</u> (Nanjing University of Science and Technology, China)
17:30	Extremely large undercooling during solidification of ternary Bi <sub>44</sub> In <sub>33</sub> Sn <sub>23</sub> triphasic nanoparticles embedded in icosahedral matrix <u>Krishanu Biswas</u> (Indian Institute of Technology, India)	Oxidation behavior of Ti-Zr-Ni-Cu metallic glass alloys <u>W. T. Kim</u> (Cheongju University, South Korea)	Microstructural evolution of Copper-(Chromium, Molybdenum, Tungsten) composites deformed by high-pressure-torsion <u>Julian M. Rosalie</u> (Erich Schmid Institute, Austrian Academy of Sciences, Austria)
17:45	Microstructure and mechanical properties Al-Cu-Fe quasicrystalline reinforced AA 6082 Al matrix composite <u>Yagnesh Shadangi</u> (Indian Institute of Technology (Banaras Hindu University, India)	Microscopic evidence of a liquid-liquid transition below the conventional glass transition temperature <u>Simon Hechler</u> (Saarland University, Germany)	Growth of single quasicrystalline grains in Al-Cu-(Fe,Cr) mechanically alloyed powders at heating <u>V.V. Tcherdyntsev</u> (National University of Science and Technology "MISIS", Russia)
18:00	Get together Barbeque		

## Tuesday, 29<sup>th</sup> August

	<b>Plenary Session II</b>		<b>Chairman: Jörg Löffler</b>
8:30	Fast surface dynamics and unique related properties in metallic glasses <u>Prof. Weihua Wang</u> (Institute of Physics, Chinese academy of Sciences, China)		
9:10	Impact melting: rapid quenching and materials chemistry in small volumes and at extremely short timescales <u>Prof. Christopher A Schuh</u> (Massachusetts Institute of Technology, USA)		
9:50	Attractiveness and usefulness of multicomponent Fe-, Zr- and Al-based glassy alloys <u>Prof. Akihisa Inoue</u> (Tianjin University, China)		
10:30	Coffee break		
11:00	Universal parameter to quantitatively predict metallic glass properties <u>Prof. Evan Ma</u> (Johns Hopkins University, USA)		
11:40	Evolution of the glassy state in the potential energy landscape <u>Prof. Takeshi Egami</u> (University of Tennessee, USA)		
12:30	Lunch and lunch break		
	Room A	Room B	Room C
	A3-Metallic glasses 3: Deformation Chairman: <u>Annett Gebert</u>	B3-Nanostructured materials 2 Chairman: <u>Christopher A Schuh</u>	C3-Metallic glasses 4: Properties Chairman: <u>Hans Fecht</u>
14:00	<b>Keynote Lecture:</b> Quantifying the commonalities in structure and plastic deformation in disordered materials <u>Daniel S. Gianola</u> (University of California Santa Barbara, USA )	<b>Keynote Lecture:</b> Fundamental compositional limitations in the thin film growth of metastable alloys <u>Jörg Neugebauer</u> (Max-Planck-Institut für Eisenforschung, Germany)	<b>Keynote Lecture:</b> Liquid-liquid transitions in metallic melts <u>Ralf Busch</u> (Saarland University, Germany)
14:30	<b>Invited Lecture:</b> Zr <sub>61</sub> Ti <sub>2</sub> Cu <sub>25</sub> Al <sub>12</sub> bulk metallic glass: Failure under torsional loading and Mode III fracture toughness <u>Jian Xu</u> (Institute of Metal Research, China)	<b>Invited Lecture:</b> Recent development on the processing, microstructure, and properties of nano-eutectic composites <u>Jayanta Das</u> (Indian Institute of Technology Kharagpur, India)	<b>Invited Lecture:</b> Exploiting the elastic properties of metallic glasses <u>K. Georgarakis</u> (Cranfield University, UK)
14:55	<b>Invited Lecture:</b> In-situ transmission electron microscopy study of freestanding amorphous thin films under stress <u>C. Rentenberger</u> (University of Vienna, Austria)	<b>Invited Lecture:</b> Outstanding soft magnetic properties of amorphous and nanocrystalline alloys <u>Roland Größinger</u> (Vienna University of Technology, 1040 Vienna, Austria)	<b>Invited Lecture:</b> Rapidly quenched and amorphous magnetocaloric alloys <u>A. Waske</u> (IFW Dresden, Germany)
15:20	Research on the thermoplastic formability of lightweight Ti-based bulk metallic glasses <u>Pan Gong</u> (Huazhong University of Science and Technology, China)	Hierarchically structured porous ceramics by rapidly freezing process <u>Dou Zhang</u> (Central South University, China)	Characterisation of corrosion products of a Ti-based metallic glass in artificial pits by in situ synchrotron X-ray diffraction <u>P. F. Gostin</u> (University of Birmingham, UK)



15:35	Development of a novel family of Bulk Metallic Glasses <u>Alexander Kuball</u> (Saarland University, Germany )	Effects of minor elements on transition energy and color change of Cu-M alloys <u>Yeon Beom Jeong</u> (Sejong University, Korea)	Effect of yttrium on surface chemistry and passivation stability in Al-based metallic glasses <u>Jiangqiang Wang</u> (Institute of Metal Research, CAS, P. R. China)
15:50	<b>Coffee break</b>		
	A4-Metallic glasses 5: Kinetics Chairman: <u>Horst Hahn</u>	B4- Undercooled melts & rapid solidification Chairman: <u>Weihua Wang</u>	C4-High-Entropy Alloys 1 Chairman: <u>Takeshi Egami</u>
16:10	<b>Keynote Lecture:</b> Phase transformations under rapid heating and cooling in metallic nanolaminates <u>Karsten Woll</u> (Karlsruhe Institute of Technology (KIT), Germany)	<b>Keynote Lecture:</b> Atomic structure changes in disordered materials under hydrostatic pressure <u>J.Z. Jiang</u> (Zhejiang University, People's Republic of China)	<b>Keynote Lecture:</b> Stability of solid solution phases in high entropy alloys <u>B.S. Murty</u> (Indian Institute of Technology Madras, India)
16:40	<b>Invited Lecture:</b> Phase evolution and kinetics in undercooled FeCoNiCu <sub>0.5</sub> alloys <u>Gandham Phanikumar</u> (Indian Institute of Technology Madras, INDIA)	<b>Invited Lecture:</b> Metastable solidification and melting in Indium-Tin system <u>Keiichi N. Ishihara</u> ( Kyoto University, Japan)	<b>Invited Lecture:</b> Cooling-rate effect on the phase-formation of high-entropy alloys <u>Yong Zhang</u> (University of Science and Technology Beijing, China)
17:05	Martensitic transformation behavior related with work-hardening on initial deformation stage of Ti-based bulk metallic glass composite <u>Sung Hwan Hong</u> (Sejong University, Seoul, Republic of Korea)	Anomalous sudden drop of temperature-dependent Young's modulus arisen from ferrite-austenite phase transition <u>Haihui Ruan</u> (The Hong Kong Polytechnic University, Hong Kong)	Optimization of soft magnetic properties of high-entropy alloys by tailoring saturation magnetostriction <u>Min Zhang</u> (University of Science and Technology Beijing, China)
17:20	The kinetics behavior of Au-based metallic glass upon ultrafast heating and cooling <u>Jia Hao YAO</u> (Institute of Metal Research, China)	Combination of the variational method with the random phase approximation for calculation the Helmholtz free energy of simple liquid metals <u>Nikolay Dubinin</u> (Institute of Metallurgy, Ural, Russian Academy of Sciences, Russia)	Nano-scale structural transformations in NiCoFeCrGa high entropy alloy as a function of heat treatments <u>Ádám Vida</u> (Eötvös University, Hungary)
17:35	The kinetic fragility of Pt-P based bulk glass-forming liquids and its thermodynamic and structural signature <u>Oliver Gross</u> (Saarland University, Germany)	Relation between self-diffusion and viscosity in liquid Ni <sub>66,7</sub> B <sub>33,3</sub> <u>Sarah Zimmermann</u> (Deutsches Zentrum für Luft- und Raumfahrt (DLR), Germany)	Thermomechanical processing of FeCoCrNi(Mn, Al) high entropy alloys <u>Nele Van Steenberge</u> (OCAS NV, Zelzate, Belgium)
18:00	<b>Poster session and reception</b>		

## Wednesday, 30<sup>th</sup> August

	<b>Plenary Session III</b>		<b>Chairman: Jörg Löffler</b>
8:30	Homogeneous Deformation of Metallic Glasses at Room Temperature Prof. A. L. Greer (University of Cambridge, UK)		
9:10	Structure and Dynamics of Hyper-Quenched Metallic Glasses Prof. Mingwei Chen (Johns Hopkins University, USA)		
9:50	Alloy nanoparticle ink for printing obtained through non-equilibrium processing Prof. Kamanio Chattopadhyay (Indian Institute of Science, India)		
10:30	Coffee break		
	Room A	Room B	Room C
	A5-Metallic glasses 6: Structure Chairman: <u>Evan Ma</u>	B5-Metallic glasses 7: Deformation Chairman: <u>Dieter M. Herlach</u>	C5-Additive manufacturing & powder metallurgy Chairman: <u>Livio Battezzati</u>
11:00	<b>Invited Lecture:</b> Phase transitions in Au based metallic glasses studied via chip calorimetry <u>Stefan Pogatscher</u> (Montanuniversitaet Leoben, Austria)	<b>Invited Lecture:</b> On the fracture behavior of bulk metallic glasses <u>Bernd Gludovatz</u> (UNSW Sydney, Australia)	<b>Invited Lecture:</b> Manufacturing of large components for the aviation using laser additive manufacturing <u>Xin Lin</u> (Northwestern Polytechnical University, P.R. China)
11:25	On the universality of cryothermal cycling as a method for structural changes in metallic glasses <u>S.V. Ketov</u> (Erich Schmid Institute of Materials Science, Austria)	Case study on Ti <sub>40</sub> Zr <sub>10</sub> Cu <sub>36</sub> Pd <sub>14</sub> bulk metallic glass: from lab-scale samples to real-size machined dental implants <u>A. Liens</u> (Université de Lyon, France)	<b>Invited Lecture:</b> Joining of selective laser melted parts <u>K.G. Prashanth</u> (Norwegian University of Science and Technology, Norway)
11:40	Characterization of the Fe <sub>67</sub> Mo <sub>6</sub> Ni <sub>3.5</sub> Cr <sub>3.5</sub> P <sub>12</sub> C <sub>5.5</sub> B <sub>2.5</sub> bulk metallic glass forming alloy <u>Benedikt Bochtler</u> (Saarland University, Germany)	Different ways to improve plasticity in bulk metallic glasses <u>Jean-Marc Pelletier</u> (Mateis, INSA-Lyon' Bat. B. Pascal, France)	
11:55	Metallic glass composites with shape memory alloys <u>Daniel Şopu</u> (TU Darmstadt, Germany)	Effect of hydrogen on the pop-in behavior in a metallic glass <u>Lin Tian</u> (University of Göttingen, Germany)	Strong and ductile Inconel 718 superalloy fabricated by additive manufacturing <u>Chao Chen</u> (Central South University, China)
12:10		Ultrasonic hammering reveals serrated energy storage ability of metallic glasses <u>S. Sohrabi</u> (Institute of Physics, Chinese Academy of Sciences, Beijing, China)	Evolution of reverted γ-Fe and precipitation in 18Ni300 manufactured by selective Laser Melting <u>W. F. Guo</u> (Southern University of Science and Technology, China)

12:30	Lunch parcel and bus departure at 12:40
14:30	Conference Excursion Riegersburg
17:30	Conference Banquet at Thaller (including wine tasting)

### **Visit to Riegersburg and Thaller vineyard**



## Thursday, 31<sup>st</sup> August

Plenary Session IV			
Chairman: Jörg Löffler			
8:30	Metastability alloy design Prof. Dierk Raabe (Max Plank Institut für Eisenforschung GmbH, German)		
	Room A	Room B	Room C
	A6-Metallic glasses 8: Structure Chairman: <u>Gerhard Wilde</u>	B6-Metallic glasses 9: Deformation Chairman: <u>Mingwei Chen</u>	C6-Severe plastic deformation 2 Chairman: <u>Deliang Zhang</u>
9:10	<b>Invited Lecture:</b> Fe <sub>36</sub> Co <sub>36</sub> B <sub>19.2</sub> Si <sub>4.8</sub> Nb <sub>4</sub> bulk metallic glasses with small Cu addition <u>Mihai Stoica</u> (ETH Zurich, Switzerland)	<b>Invited Lecture:</b> Tuning for the deformation mode in nanoscale metallic glasses <u>Eun Soo Park</u> ( Seoul National University, Republic of Korea )	<b>Keynote Lecture:</b> Nanocrystalline steels produced by ball milling, high pressure torsion and wire drawing <u>Reiner Kirchheim</u> (Universität Göttingen, Germany)
9:40	<b>Invited Lecture:</b> Surface patterning of Ni-free Ti- and Zr-based bulk metallic glasses via thermoplastic forming <u>Mariana Calin</u> (Leibniz Inst. for Sol. State and Materials Research Dresden, Germany)	<b>Invited Lecture:</b> A universal deformation mechanism for metallic glasses <u>Harald Rösner</u> (Westfälische Wilhelms-Universität Münster, Germany)	<b>Invited Lecture:</b> Grain refinement in powder metallurgical FeCoCrNi high entropy alloy during room temperature severe plastic deformation <u>Yong Liu</u> (Central South University, P.R.China)
10:05	Electronic structure of Zr <sub>45</sub> Cu <sub>45</sub> Ag <sub>10</sub> bulk metallic glass <u>Shinya Hosokawa</u> (Kumamoto University, Japan)	Mechanical and thermal properties of Palladium based bulk metallic glasses regarding relaxation and rejuvenation <u>Niklas Nollmann</u> ( Westfälische Wilhelms-Universität Münster, Germany)	Comparative investigation of oxygen effects in Cu-Fe nanocrystalline alloys deformed by high pressure torsion <u>Jinming Guo</u> (Erich Schmid Institute of Materials Science, Austria)
10:20	Investigation of amorphous Fe-based alloy ribbons <u>Erzhena N. Zanaeva</u> (Lab. of Adv. Green Materials, NUST MISiS, Russia )	In situ TEM deformation of a bulk metallic glass <u>Christoph Gammer</u> (Erich Schmid Institute of Materials Science, Austria)	The synthesis of free standing ultra-pure metal nanoparticles in large quantity <u>Nirmal Kumar</u> (Indian Institute of Technology Kanpur, India)
10:30	Coffee break		
	A7- Metallic glasses 10: Properties Chairman: <u>Dierk Raabe</u>	B7-Metallic glasses 11: Structure Chairman: <u>Akihisa Inoue</u>	C7-High-Entropy Alloys 2 Chairman: <u>B.S. Murty</u>
11:00	<b>Invited Lecture:</b> Nanostructured Metallic Glasses: Insights from MD simulations Karsten Albe (TU Darmstadt, Germany)	<b>Invited Lecture:</b> The role of structural heterogeneities in bulk metallic glass <u>Hans Fecht</u> (Ulm University, Germany)	<b>Invited Lecture:</b> Design of advanced metastable titanium alloys for functional biomedical devices <u>T. Gloriant</u> (Inst. Sci. Chim., INSA Rennes)
11:25	Using strains in the elastic regime to enhance the properties of metallic glasses <u>C. M. Meylan</u> (University of Cambridge, UK)	Correlation between structural and mechanical heterogeneities of a CuZr based bulk metallic glass <u>Christian Ebner</u> (University of Vienna, Austria)	<b>Invited Lecture:</b> Insights into the thermal stability and deformation behavior of the CrMnFeCoNi high-entropy alloy revealed by nanoindentation <u>Verena Maier-Kiener</u> (MUL Leoben, Austria)

11:40	High pressure quenched glasses – unique structures and properties <u>Wojciech Dmowski</u> (University of Tennessee, USA)	Radial distribution function imaging: a TEM method in resolving the multiphase amorphous materials <u>Xiaohe Mu</u> (Karlsruhe Institute of Technology (KIT), Germany)	
11:55	Role of amorphous 2nd phase on electric property and magnetic property in Cu-Zr-Al-Gd phase separating metallic glasses <u>Sang Jun Kim</u> (Seoul National University, Republic of Korea)	Alloy development of 18-karat premium-white gold bulk metallic glasses with improved tarnishing resistance <u>Nico Neuber</u> (Saarland University, Germany)	Experimental measurement of pseudo-binary phase diagram of FeCoCrNi-Cu complex concentrated alloys <u>K.N. Yoon</u> (Seoul National University, Republic of Korea)
12:10	Melt fluxing to elevate the forming ability of Al-based bulk metallic glasses <u>Baijun Yang</u> (Institute of Metal Research, P. R. China)	HRTEM investigation of nanocrystals and magnetic structure of FeNi-based BMGs <u>Baran Sarac</u> (Erich Schmid Institute of Materials Science, Austria)	Microstructure and mechanical properties of Ta-Nb-V-(Ti,W,Mo) high entropy alloys by mechanical alloying and spark plasma sintering <u>Jong Hwa Lim</u> (Kongju National University, Republic of Korea)
12:25		Sub-ablation femtosecond laser processing of nanocrystalline alloys and metallic glasses <u>Glenn H. Balbus</u> (The University of California, Santa Barbara, USA)	Synthesis and Characterization of AlCoCrFeNi high entropy alloy (HEA) processed by mechanical alloying and microwave sintering <u>VikasShivam</u> (Indian Institute of Technology (BHU), INDIA)
12:30	Lunch and lunch break		

## Thursday, 31<sup>st</sup> August (continued)

	A8-Metallic glasses 12: Structure & kinetics & severe plastic deformation 3 Chairman: <u>Roland Würschum</u>	B8-Thin films 1 & metallic glass 13: properties Chairman: <u>Christian Mitterer</u>	C8-Undercooled melts and rapid solidification Chairman: <u>Karsten Albe</u>
14:00	<b>Keynote Lecture:</b> Shear bands in metallic glasses: atomic transport, propagation and relaxation behavior <u>Gerhard Wilde</u> (University of Münster, Germany)	<b>Keynote Lecture:</b> Quantum mechanically guided materials design and experimentally guided quantum mechanical calculations of short range ordered thin film materials <u>Jochen M. Schneider</u> (RWTH, Germany)	<b>Keynote Lecture:</b> Advanced Structure Analysis of Hard Magnetic Al-Mn Alloys <u>P. Švec</u> (Institute of Physics, Slovak Academy of Sciences, Slovakia )
14:30	<b>Invited Lecture:</b> In-situ investigation of cracking and stress corrosion cracking in Zr-based bulk metallic glass <u>David Geissler</u> (Leibniz-Institute for Solid State and Materials Research, Germany)	<b>Invited Lecture:</b> In situ small scale fracture experiments: A new tool for developing quenched materials <u>Christoph Kirchlechner</u> (Max-Planck-Institut für Eisneforschung, Germany)	<b>Invited Lecture:</b> Metastable Ti-based alloys for biomedical use <u>Annett Gebert</u> (Leibniz Institute for Solid State and Materials Research Dresden, Germany )
14:55	<b>Invited Lecture:</b> Limiting factors for deformation-induced supersaturation during severe plastic deformation <u>Karoline Kormout</u> (Erich Schmid Institute of Materials Science, Austria)	<b>Invited Lecture:</b> Structure and approach of the mechanical strength and deformation of nano porous silver prepared by de-alloying <u>Yannick Champion</u> (Univ. Grenoble Alpes, France)	<b>Invited Lecture:</b> Hydroxyapatite coated and non-coated novel Fe-Mn-Si-Pd biocompatible alloys, designed for biomedical applications <u>M.D. Baró</u> (Universitat Autònoma de Barcelona, Spain)
15:20		In-situ methods to study electro-mechanical behavior of flexible electronic materials <u>Barbara Putz</u> (Erich Schmid Institute of Materials Science, Austria)	Rapid dendritic solidification and physical properties of Co-4.54%Sn alloy with broad mushy zone <u>W.L. Wang</u> (Northwestern Polytechnical University, China)
15:35	Coffee break		
16:00	<b>Keynote Lecture:</b> Structural instabilities during deformation of nanostructured materials <u>O. Renk</u> (Erich Schmid Institute of Materials Science, Austria)	Transverse excitations in a Pd-Ni-Cu-P alloy of the liquid and supercooled liquid phases <u>Shinya Hosokawa</u> (Hiroshima University, Japan)	An experimental study of thermophysical properties for liquid and solid binary Ti-Nb <u>K. Zhou</u> (Northwestern Polytechnical University, China)
16:15		Effect of Au addition on the corrosion activity of Ca-Mg-Zn bulk metallic glasses in Ringer's solution <u>Rafał Babilas</u> (Silesian University of Technology, Poland)	Rapid crystallization of undercooled liquid Ag-Si and Ag-Cu-Si alloys <u>Delu Geng</u> (Northwestern Polytechnical University, China)
16:30	Thermodynamics, kinetics, and sub-T <sub>g</sub> relaxations of Mg-based bulk metallic glasses <u>Maximilian Frey</u> (Saarland University, Germany)	Powder metallurgy of W-Cu material synthesized by hot consolidation process <u>A.K. Chaubey</u> (CSIR- Institute of Minerals and Materials Technology (CSIR-IMMT), India)	Thermophysical properties and dendrite growth kinetics of supercooled liquid refractory W-Ta Alloys <u>L. Hu</u> (Northwestern Polytechnical University, China)
17:00	Poster session and reception		



Friday, 1 <sup>st</sup> September				
	Room A		Room B	Room C
	A9-Thin films 2 Chairman: <u>Jochen M. Schneider</u>		B9- Additive manufacturing & powder metallurgy Chairman: <u>K.G. Prashanth</u>	C9-Rapid solidification 3 Chairman: <u>P. Švec</u>
8:30	<b>Keynote Lecture:</b> Reactive and non-reactive sputter deposition of MoO <sub>x</sub> thin films <u>Christian Mitterer</u> (Montanuniversität, Leoben, Austria)		<b>Keynote Lecture:</b> Microstructures and mechanical properties of bulk ultrafine and fine structured metallic materials from powders <u>Deliang Zhang</u> (Northeastern University, China)	<b>Keynote Lecture:</b> Dendrite growth in undercooled melts of glass-forming metallic alloys <u>Dieter M. Herlach</u> (Deutsches Zentrum für Luft- und Raumfahrt, Germany)
9:10	<b>Invited Lecture:</b> Revealing the interface effects in hard coatings at the atomic level <u>Zaoli Zhang</u> (Erich Schmid Institute of Materials Science, Austria)		<b>Invited Lecture:</b> SLM from a metallurgical point of view - influencing parameters, microstructures, defects and development of new alloys <u>Bruno Buchmayr</u> (Montanuniversitaet Leoben, Austria)	<b>Invited Lecture:</b> Hydrogen and amorphous alloys: friends or foes? <u>Michael Ferry</u> (The University of New South Wales, Australia)
9:35	<b>Invited Lecture:</b> Metastable single-phase rock salt structure VAIN thin films grown by Al <sup>+</sup> subplantation <u>G. Greczynski</u> (Linköping University, Sweden)		<b>Invited Lecture:</b> Additive manufacturing of strong and ductile Cu-15Ni-8Sn <u>Kechao Zhou</u> (Central South University, Changsha, China)	Melt spinning based Metal Alloy Microfibers <u>Elham Sharifikolouei</u> (Max Planck Institute for Medical Research, Germany)
10:00	Enhanced atomic interdiffusion of immiscible elements Fe/Cu in amorphous FeZr/CuZr multilayers <u>Tao Feng</u> (Nanjing University of Science & Technology, China)		Synthesis of gas atomized titanium powder for additive manufacturing <u>Taek-Soo Kim</u> (Korea Institute of Industrial Technology, Republic of Korea)	Effect of Be addition on glass-quasicrystal forming ability and mechanical properties in Ti-Zr-Ni alloys <u>G.H. Yoo</u> ( <i>Seoul National University, Republic of Korea</i> )
10:15	In-situ tensile deformation of thin film metallic glasses <u>Marlene Mühlbacher</u> (Montanuniversität Leoben, Austria)		Electrical and mechanical properties of gas atomized copper-iron metastable alloys <u>Taek-Soo Kim</u> (Korea Institute of Industrial Technology, Republic of Korea)	
10:30	Coffee break			
	Plenary Session V		Chairman: Peter Schumacher	
10:50	Structure and properties of nanoglasses <u>Prof. Horst Hahn</u> (Karlsruhe Institute of Technology, German)			
11:30	Fragility in metallic liquids and glass formation <u>Prof. Kenneth F. Kelton</u> (Washington University, USA)			
12:10	RQ16 Distinguished Fellowship Award Ceremony			
12:40	Closing ceremony and poster award			
13:00	Lunch and lunch break			

## RQ Fellowship

### Dieter M. Herlach

(Deutsches Zentrum für Luft- und Raumfahrt, Germany)

Dieter Herlach began his research at RWTH Aachen, working with Wassermann and von Löhneysen on metallic glasses and amorphous spin glasses. His first journal paper (1981) was on 'Phonon scattering by electrons and low-energy excitations in a metallic glass' [*Solid State Commun.* **39** (1981) 591], and an early paper 'The evaluation of hyperfine field distributions in overlapping and asymmetric Mössbauer spectra: a study of the amorphous alloy Pd<sub>77.5</sub>-xCu<sub>6</sub>Si<sub>16.5</sub>Fe<sub>x</sub>' [*J. Phys. F* **13** (1983) 675] is now very well cited (205 cites). His work on containerless solidification started when he moved to the DLR (then the DFVLR) near Cologne. The key first paper 'Containerless undercooling of bulk Fe-Ni melts' [*Appl. Phys. Lett.* **49** (1986) 1339] now has 72 citations. This work was at first largely based on electromagnetic levitation (EML). Dieter is prominent in developing this and other methods to achieve containerless undercooling and solidification. Dieter's work has also greatly advanced our understanding of the properties of liquids, particularly undercooled liquids: enthalpy, specific heat, surface tension, viscosity, liquid-liquid phase separation, short-range ordering. Dieter's publication record is excellent. Looking at the *Web of Science* on today's date, he has 291 papers, attracting some 350 citations per year, and with a Hirsch index of 44. His most cited publication is his review 'Nonequilibrium solidification of undercooled metallic melts' [*Mater. Sci. Eng. R* **12** (1994) 177] (375 cites).



Dieter has consistently been a leader in his field in particular he has, as sole author or as the leader of co-authors, been responsible for several key review articles that have served to define the field and identify key issues for future research. Throughout his career he has led many prominent research collaborations, ranging from an early EU Brite-Euram project to DFG Schwerpunkt programmes. His efforts have been very influential, for example in attracting support for comparative studies of metallic and colloidal systems. Most importantly he is the eminent person in the field of containerless processing and solidification – thereby setting priorities for future research funding. Additionally he has chaired European Space Agency, and other, committees and working groups.



## **RQ Fellowship**

### **Hans Warlimont**



Professor Hans Warlimont was born on September 4, 1931, in Osnabruck, Germany. A diplome in metallurgical engineering, he obtained his Doctor of Philosophy from Max Planck Metal Research, Stuttgart, Germany in the year 1959. After a brief stay of three years at United State Steel Corporation he came back to Max Planck Institute and headed the research group on metals from 1962 to 1974. During this period he has carried out outstanding work on Martensitic Transformation and order disorder transformation. During this period he developed a strong interest in the field of rapid solidification as well as an interest to translate the basic research to application. He moved in 1972 to head the research Division in Swiss Aluminium where he stayed for three years. In 1977, he moved to as director of research to Vakuumschmelze and played a leadership role in the development and application of metallic glass. He served as Science director of Institute für Festkörper und Werkstofforschung, Dresden, Germany from 1992 to 1998. Following this, he was closely associated with DSL Dresden Materials Innovation GMBH till 2010.

Although in early years, Professor Warlimont has contributed significantly to the martensitic transformation of copper based alloys and the basic understanding of order-disorder transformation, his fascination of the discovery of metallic glass by Prof. Paul Duwez and the subsequent development drew him to this field. He started playing a significant leadership role in the late seventies and eighties not only through research and development of the science of metallic glass and its applications but also to the RQ community. He contributes along with Dr Herzer to the development of the nanocrystalline soft magnetic materials and the leadership role that he played in the development of the successful product by the Vakuumschmelze. Even in later years, he tried developing newer catalyst through rapid solidification processing.

He made a significant effort in nourishing and sustaining the RQ community by organising one of the most successful RQ conferences in Wurzburg, Germany in 1984 and played a pivotal role from the late seventies to late nineties. He was an active member of the international committee in the eighties and nineties and contributed significantly to the continuing progress of the RQ conferences and the bond that it has created in the community.

## Poster Session

(Open from 18:00, 29<sup>th</sup> August to 20:00, 31<sup>st</sup> August)

### Metallic glasses

#### P-1

**Crystallization behavior of the  $\text{Al}_{86}\text{Ni}_8\text{Y}_6$  metallic glass forming alloy upon rapid cooling**

Alexander Kuball (Saarland University, Germany)

#### P-2

**Fractal abnormal grain growth in  $\text{Pd}_x\text{Au}_{100-x}$  — the rule or the exception?**

Raphael Zeller (Ulm University, Germany)

#### P-3

**Effect of additional element on microstructure and mechanical properties of Ti-based ultrafine eutectic alloy**

Young Seok Kim (Sejong University, Republic of Korea)

#### P-4

**Enhancement of glass forming ability of superelastic Ni-Ti-Cu-Zr alloy**

J.S. Kim (Yonsei University, South Korea)

#### P-5

**Gas-pressure infiltrated Al-based MMC with  $\text{Ni}_{60}\text{Nb}_{20}\text{Ta}_{20}$  metallic glass: Characterization by Analytical Transmission Electron Microscopy**

Dorothée Vinga Szabó (Karlsruhe Institute of Technology (KIT), Germany)

#### P-6

**Investigation on Gd-based metallic glass alloys for magnetic refrigerant development**

Yea Bin Moon (Sejong University, Korea)

#### P-7

**Low temperature peculiarities of plastic deformation of several bulk metallic glasses**

Elena D. Tabachnikova (B. Verkin Institute for Low Temperature Physics & Engineering, Ukraine)

#### P-8

**Magnetic properties of amorphous alloys of rhenium with rare-earth metals**

Alexey V. Bondarev (Voronezh State Technical University, Russia)

#### P-9

**Magnetism and magnetostriction in amorphous  $\text{Fe}_{50}\text{Si}_{10}\text{Mo}_{10}\text{Co}_{10}\text{B}_{15}$  meltspun ribbons**

Roland Gröbinger (Vienna University of Technology, Austria)

## **Metallic glasses (continued)**

### **P-10**

#### **Mechanical behavior of super-elastic phase dispersed metallic glass composites**

Y.S. Kim (Yonsei University, South Korea)

### **P-11**

#### **Effect of amorphous alumina on the high temperature deformation behavior of B2 Aluminides**

Niraj Chawake (Indian Institute of Technology Madras, India)

### **P-12**

#### **Oxidation behavior of Ti-Zr-Ni-Cu quaternary metallic glass**

M. Y. Na (Yonsei University, South Korea)

### **P-13**

#### **Signature of the atomic structure in the thermophysical properties of flint and metallic glasses**

Simon Hechler (Saarland University, Germany)

### **P-14**

#### **Structure and magnetic properties of Fe-based nanocrystalline soft magnetic alloys**

Viktoriia Basykh (Warsaw University of Technology, Poland)

### **P-15**

#### **Effect of minor alloying elements addition on the glass forming ability of Ni-Ti-Cu-Zr alloy exhibiting superior superelasticity after crystallization**

W.C. Kim (Yonsei University, South Korea)

### **P-16**

#### **A comparison of thermodynamic and kinetic fragilities of bulk metallic glass forming liquids**

Maximilian Frey (Saarland University, Germany)

### **P-17**

#### **Microstructure evolution of ZrCuAgAl metallic glass processed by high pressure torsion**

Suya Liu (Karlsruhe Institute of Technology (KIT), Germany)

## **Rapid Solidification**

### **P-18**

#### **A new indicator of thermoplastic formability reflecting the stability of Newtonian viscous flow in supercooled liquid region**

Hyun Seok Oh (Seoul National University, Republic of Korea)

## Rapid Solidification (continued)

### P-19

#### **Micro-sized superelastic FeNiCoAl-based alloys prepared by rapid quenching from the melt**

Firuta Borza (National Institute of R&D for Technical Physics, Romania)

### P-20

#### **Correction to the Wills-Harrison approach: influence on the Fe-based liquid alloys thermodynamics**

Nikolay Dubinin (Institute of Metallurgy of the Ural Branch of the Russian Academy of Sciences, Ekaterinburg, Ural Federal University, Ekaterinburg, Russia)

### P-21

#### **Development of copper alloys with $\beta$ -phases for mechanical properties**

Tae-Hoon Park (Advanced-Functional Materials R&D Group, KITECH, Incheon, Korea)

### P-22

#### **Effects of wheel material on amorphous ribbon formation in planar flow casting in air**

Yuta Kunibu (Tohoku University, Japan)

### P-23

#### **Investigation of $(\text{Ti}_{65}\text{Fe}_{35})_{100-x}(\text{Bi}_{53}\text{In}_{47})_x$ hypereutectic alloys with $\beta$ -Ti dendrite**

Yun Jung Hwang (Sejong University, Republic of Korea)

### P-24

#### **Rapidly solidified amorphous and nanocrystalline $\text{Fe}_{73.5}\text{Cu}_1\text{Nb}_3\text{Si}_{13.5}\text{B}_9$ nanowires**

Tibor-Adrian Óvári (National Institute of Research and Development for Technical Physics, Romania)

### P-25

#### **Fabrication of mono-dispersed amorphous $\text{Fe}_{76}\text{Si}_9\text{B}_{10}\text{P}_5$ particles by container-less solidification process and their soft magnetic property**

Noriharu Yodoshi (Tohoku University, Sendai, Japan)

### P-26

#### **Improved synthesis of $\text{La}(\text{Fe,Si})_{13}$ via rapid quenching and production of amorphous metal matrix composites**

Alexander Funk (IFW Dresden, Germany)

### P-27

#### **Statistical analysis of serrated flow in TZN quasicrystals fabricated by different cooling rates**

G.H. Yoo (Seoul National University, Seoul 151-744, Republic of Korea)

## High-Entropy Alloys

**P-28**

**A strategy for overcoming strength-ductility trade off in BCC high-entropy alloy**

Eun Soo Park (Seoul National University, Seoul, Republic of Korea)

**P-29**

**Light weight FCC complex concentrated alloys with TRIP behavior**

Kooknoh Yoon (Seoul National University, Republic of Korea)

**P-30**

**Study on the microstructure and mechanical properties of equi-atomic substituted high-entropy alloys**

Hae Jin Park (Sejong University, Republic of Korea)

## Additive manufacturing

**P-31**

**Effect of scan strategy and annealing on microstructure and properties of 316L stainless steel synthesized by selective laser melting**

O.O. Salman (IFW Dresden, Germany)

**P-32**

**Heat-treatable Al alloys produced by selective laser melting**

P. Wang (IFW Dresden, Germany)

**P-33**

**Effect of heat treatment on morphology evolution of  $\gamma'$  phase of laser additive manufactured K465 nickel-based superalloy**

Qiuge Li (Northwestern Polytechnical University, P.R. China)

## Thin films

**P-34**

**Preparation method of porous Titania( $\text{TiO}_2$ ) thin film using cellulose nanocrystal**

Yonghee Yoon (Sejong University, Seoul, Korea)

**P-35**

**Optimization of Ti-based coating layer as various deposition time with PVD method**

Young Hoon Lee (Sejong University, Republic of Korea)

## Thin films (Continued)

### P-36

#### **Influence of preparation conditions on the microstructure and magnetic properties of rapidly quenched cold-drawn and glass-covered FINEMET thin wires**

H. Chiriac (National Institute of Research and Development for Technical Physics, Romania)

### P-37

#### **Selected properties of nanometric TiO<sub>2</sub> coating on biodegradable Mg alloys**

Aneta Kania (Silesian University of Technology, Gliwice, Poland)

### P-38

#### **Interdiffusion and metastable phase formation in Ag/Al multilayer thin films studied by atom probe tomography**

Isabella Gallino (Saarland University, Saarbrücken, Germany)

### P-39

#### **Amorphous/Amorphous Metallic Multilayers**

F. Spieckermann (Montanuniversität Leoben, Austria)

## Powder metallurgy

### P-40

#### **Consolidation of amorphous powder by thermoplastic forming and mechanical testing**

Benedikt Bochtler (Saarland University, Germany)

### P-41

#### **Influence of milling parameters on the formation of c-LLZO by mechanochemical processing**

Dariusz Oleszak (Warsaw University of Technology, Poland)

### P-42

#### **Structural and magnetic properties of magnetocaloric Gd-Si-Ge-(Mn) alloys by ball milling**

Dong Sun Seo (Kongju National University, Republic of Korea)



