

Program

Nanomechanical Testing In Materials Research and Development

October 9-14, 2011

Lanzarote, Canary Islands, Spain

Conference Chair:

Prof. Dr. Gerhard Dehm

**Department Materials Physics, University of Leoben
and**

Erich Schmid Institute of Materials Science of the Austrian Academy of Science



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Sunday, October 9, 2011

15:00 – 18:00	Registration
18:00 – 19:00	Welcome Reception
19:00 – 20:30	Dinner
	Opening Session
20:30 – 20:40	Welcome Conference Chair: Gerhard Dehm, University of Leoben, Austria
20:40 – 21:20	Topological optimization, fabrication, and characterization of 3-dimensional micro/nanoscale materials (Plenary) Kevin Hemker, Johns Hopkins University, MD, USA
21:20 - 22:00	Measuring nanoscale deformation in complex materials with synchrotron radiation X-rays (Plenary) Oskar Paris, University of Leoben, Austria

Notes

- *Breakfast will be served in the restaurant each day.*
- *Lunch locations will be announced on site but will generally be outside.*
- *Dinners will be in the restaurant except for the Fish BBQ banquet which will be outside.*
- *Technical and poster sessions will be in the Tagororo meeting room.*
- *Audiotaping, videotaping and photography of presentations are prohibited.*
- *Speakers – Please have your presentation loaded onto the conference computer prior to the session start (preferably the day before).*
- *Speakers – Please leave at least 3-5 minutes for questions and discussion.*
- *Please do not smoke at any conference functions.*
- *Turn your mobile telephones to vibrate or off during technical sessions.*
- *Be sure to make any corrections to your name/contact information on the Master Participant List or confirm (by your initials) that the listing is correct. A corrected copy will be sent to all participants after the conference.*

Monday, October 10, 2011

07:30 – 09:00 Breakfast buffet

Micromechanics, Fracture and Fatigue

09:00 – 09:30 **Nanomechanical testing of materials and thin films with the bulge test (Invited)**
Mathias Göken, University of Erlangen-Nürnberg, Germany

09:30 – 09:50 **Initial plasticity of thin wires in torsion under forward and reversed loading (R)**
Andy Bushby, Queen Mary University of London, UK

09:50 – 10:10 **Small scale plasticity of silicon as a function of electronic doping (R)**
Rudy Ghisleni, Laboratory for Mechanics of Materials and Nanostructures – EMPA, Switzerland

10:10 – 10:30 **Effects of constraints in plasticity on cleavage fracture of tungsten single crystalline samples (R)**
Stefan Wurster, Austrian Academy of Sciences, Austria

10:30 – 11:00 Coffee break

11:00 – 11:30 **Yield and plastic flow in small volumes in soft metals in tension and flexure (Invited)**
David Dunstan, Queen Mary University of London, UK

11:30 – 12:00 **Ductility in highly nanotwinned copper – myth or reality? (I)**
Andrea Hodge, University of Southern California, CA, USA

12:00 – 12:20 **Ultra-high strain hardening in nanocrystalline palladium thin films with nanotwins: an experimental study coupled to a phenomenological analytical model (R)**
Marie-Stephane Colla, University Catholique de Louvain, Belgium

12:20 – 12:40 **Fracture testing – From the microscale to the macroscale (R)**
David Armstrong, University of Oxford, UK

12:40 – 13:00 **Hydrogen embrittlement characterization of Fe-26Al-xCr Intermetallics with the aid of *in-situ* nanoindentation Technique (R)**
Afrooz Barnoush, Saarland University, Germany

13:00 – 14:00 Lunch

14:00 – 16:00 Free time /*ad hoc* sessions

16:00 – 16:30 Afternoon coffee and snacks

In-situ Testing

16:30 – 17:10 **Uniaxial tensile testing of nanowires (Plenary)**
Reiner Mönig, Karlsruhe Institute of Technology, Germany

17:10 – 17:30 **Mechanical properties of Cu nanowires by in situ bending experiments (R)**
Gunther Richter, MPI for Intelligent Systems, Germany

17:30 – 18:00 **Micro-objects in-situ deformation of as a tool to uncover the role of dislocation nucleation in the brittle-to-ductile transition in InSb semi-conductor (Invited)**
Ludovic Thilly, University of Poitiers, France

Monday, October 10, 2011 (continued)

- 18:00 – 18:20 **Modifying mechanical properties on a nanometer scale by controlled annealing of crystal defects (R)**
Daniel Kiener, University of Leoben, Austria
- 18:20 – 18:50 **Tensile properties of nano-twinned Cu nano-pillars through in-situ mechanical testing, electron microscopy, and atomistic simulations (Invited)**
Julia Greer, California Institute of Technology, USA
- 18:50 – 19:30 Poster Preview I
- 19:30 – 21:00 Dinner
- 21:00 – 23:00 Poster Session I with social hour

Tuesday, October 11, 2011

07:30 – 09:00 Breakfast

Indentation I

09:00 – 09:40 **Multiscale modeling of indentation: From atom to continuum (Plenary)**
Marc Fivel, SIMaP-GPM2, France

09:40 – 10:00 **Single crystal plasticity of titanium quantified through orientation informed nanoindentation and crystal plasticity finite element simulation (R)**
Claudio Zambaldi, MPI for Iron Research, Germany

10:00 – 10:20 **Elastic anisotropy of materials studied by nanoindentation and atomic force acoustic microscopy Techniques (R)**
Kong Boon Yeap, Fraunhofer Institute for Nondestructive Testing, Germany

10:20 – 10:40 **New method based on second harmonic detection to extract mechanical properties from dynamic nanoindentation Tests (R)**
Jean-Luc Loubet, Ecole Centrale de Lyon, France

10:40 – 10:10 Coffee break

10:10 – 11:40 **Mechanical properties mapping using probe experiments: Fact and fiction (Invited)**
Warren C. Oliver, Nanomechanics Inc., TN, USA

10:40 – 12:00 **In situ, elevated temperature nanoindentation: Best practices and case studies (R)**
J.M. Wheeler, Mechanics of Materials and Nanostructures Laboratory – EMPA, Switzerland

12:00 – 12:30 **Hot microcompression in vacuum up to 700°C (Invited)**
S. Korte, University of Cambridge, UK

12:35– 13:30 Lunch

13:30 – 16:00 Free time / *ad hoc* sessions

16:00 – 16:30 Afternoon coffee with snacks

Indentation II

16:30 – 17:00 **Extracting mechanical properties of copper coatings on stiff and compliant substrates by nanoindentation (Invited)**
Steve Bull, Newcastle University, UK

17:00 – 17:20 **Twin boundary motion in MAX phase materials activated by nanoindentation (R)**
Christoph Tromas, University of Poitiers, France

17:20 – 17:50 **Nanoindentation strain-rate jump and long-term creep tests on nanocrystalline materials (R)**
Verena Maier, University of Erlangen-Nuernberg, Germany

17:50 – 18:10 **The interpretation of spherical indentation through multiscale material modeling: from polycrystalline to single-crystal micro and nano-indentations (R)**
J. Alcalá, Universitat Politècnica de Catalunya, Spain

Tuesday, October 11, 2011 (continued)

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|---------------|--|
| 18:10 – 18:30 | Nanoindentation based assessment of effective composite properties (R)
J. Nemecek, Czech Technical University in Prague, Czech Republic |
| 18:30 – 18:50 | Obtaining crystal plasticity parameters by inverse analysis of nanoindentation results (R)
Benjamin Schmaling, ICAMS – Ruhr-University Bochum, Germany |
| 18:50 – 19:30 | Poster Preview II |
| 19:30 – 21:00 | Dinner |
| 21:00 – 23:00 | Poster Session II |

Wednesday, October 12, 2011

07:30 – 09:00 Breakfast

Deformation Mechanisms I

09:00 – 09:40 **Observation of dislocation-movement in passivated AL film using in situ transmission electron microscopy nanoindentation (Plenary)**
Marc Legros, CEMES-CNRS, France

09:40 – 10:10 **Size dependence of strength of metallic micropillars and the prerequisites for the formation of stable pinning points (Invited)**
Seok-Woo Lee, Stanford University, CA, USA

10:10 – 10:40 **Initial dislocation structures and boundary conditions in 3D discrete dislocation dynamics simulations and their influence on micro scale plasticity (Invited)**
Christian Motz, Austrian Academy of Sciences, Austria

10:40 – 11:10 Coffee break

11:10 – 11:30 **A simple stochastic model for yielding in specimens with a limited number of dislocations (R)**
George M. Pharr, University of Tennessee, TN, USA

11:30 – 11:50 **Influence of bulk pre-straining on the size effect in nickel compression pillars (R)**
Andreas Schneider, Leibniz Institut fuer neue Materialien, Germany

11:50 – 12:10 **Emergence of strain rate sensitivity in Cu nano-pillars: Transition from dislocation multiplication to dislocation nucleation (R)**
Andrew T. Jennings, California Institute of Technology, USA

12:10 – 12:40 **Exploiting interactions between indentation size and structure size effects to determine the characteristic dimension of nano-structured materials by indentation (Invited)**
Nigel M. Jennett, National Physical Laboratory, UK

13:00 – 19:00 Boxed lunch and excursion to Timanfaya National Park

20:00 – 23:00 Dinner

Thursday, October 13, 2011

07:30 – 09:00 Breakfast

Deformation Mechanisms II

09:00 – 09:40 **3DXRD - Results, limitations and outlook (Plenary)**
Dorte Juul Jensen, Risoe DTU, Denmark

09:40 – 10:00 **Expected and unexpected plastic behavior at the micron scale: An in situ Laue study (R)**
Christoph Kirchlechner, University of Leoben, Austria

10:00 – 10:30 **Probing strain hardening behavior in multilayer nanolaminate systems (Invited)**
David Bahr, Washington State University, WA, USA

10:30 – 11:00 Coffee break

11:00 – 11:30 **Testing of Ultra-sensitive materials for nano-electromechanical system - USENEMS (Invited)**
Peter Schaaf, TU Ilmenau, Germany

11:30 – 11:50 **Yield and buckling in nanowire arrays (R)**
Matthias Schamel, ETH Zurich, Switzerland

11:50 – 12:20 **Fracture toughness of micron-sized NiAl single crystalline cantilevers (Invited)**
Karsten Durst, University of Erlangen-Nürnberg, Germany

12:20 – 12:50 **Effect of ion irradiation on the micropillar compression of LiF single crystals (Invited)**
Jon M. Molina-Aldareguia, IMDEA Materials Institute, Spain

13:00 – 14:30 Lunch

14:30 – 16:00 Free time / *ad hoc* sessions

16:00 – 16:30 Afternoon coffee with snacks

New Instrumentations and Developments

16:30 – 16:50 **Measuring substrate-independent elastic modulus of stiff and compliant films by nanoindentation**
Holger Pfaff, Agilent Technologies, Germany

16:50 – 17:10 **Compact test platform for in-situ materials characterization in various fields of microscopy**
Stephan Fahlbusch, Alemnis GmbH, Switzerland

17:10 – 17:30 **Recent applications of nanoindentation measurements and evolutions of instrumentation**
Philippe Kempe, CSM Instruments SA, Switzerland

17:30 – 17:50 **Innovations for mechanical testing at nanoscale**
Ude Hangen, Hysitron, USA

17:50 – 18:10 **A simple new method to measure force displacement curves**
Stephan Kleindiek, Kleindiek Nanotechnik GmbH, Germany

Thursday, October 13, 2011 (continued)

- 18:10 – 18:30 **Thermal drift in high temperature indentation: A non-displacement based approach**
Vincent Jardret, Michalex, France
- 18:30 – 18:50 **TIP Radii effects on the failure produced in ultra-thin films by scratch testing**
Bryan Crawford, Nanomechanics Inc., USA
- 18:50 – 19:10 **Nanomechanical Testing at high temperatures: New solutions for more accuracy**
Wolfgang Stein, SURFACE, Germany
- 19:30 – 22:00 Conference Banquet

Friday, October 14, 2011

07:30 – 09:00 Breakfast

“Novel” Materials

09:00 – 09:40 **A combinatorial approach using nano scanning calorimetry and x-ray diffraction to study the effect of composition and quench rate on the crystallization of Au-Si-Cu metallic glasses during rapid heating (Plenary)**

Joost J. Vlassak, Harvard University, USA

09:40 – 10:00 **The effect of topography features on modulus mapping of nanoscale interfaces in a deep sea sponge (R)**

Igor Zlotnikov, MPI of Colloids and Interfaces, Germany

10:00 – 10:20 **Temperature dependence of visco-elastic properties of polymer thin films using nanoindentation (R)**

Diana Courty, ETH Zurich, Switzerland

10:20 – 10:40 **Multiscale approach to plastic deformation of silicate glasses at the micron scale (R)**

Etienne Barthel, CNRS / Saint-Gobain, France

10:40 – 11:30 General Discussion

12:00 – 13:30 Lunch and Departure

Poster Presentations

1. **Synthesis and characterization of bundle-like CeO₂ nanofibers**
Ruixing Li, Beihang University, China
2. **Determination of fracture properties of (Pt,Ni)Al bond coats by microbeam bend tests**
Jaya B Nagamani, Indian Institute of Science, India
3. **Deformation mechanisms of nanocomposite metals composed of a Cu matrix reinforced by Nb nanowhiskers studies by in-situ deformation in the TEM and under synchrotron beam**
Ludovic Thilly, University of Poitiers, France
4. **Mechanical properties of superelastic hard carbon materials produced by high-pressure high-temperature treatment of fullerenes**
Olga P. Chernogorova, Baikov Institute of Metallurgy and Materials Sciences RAS, Russia
5. **Nanoindentation applied to ion-irradiated iron-chromium alloys**
Frank Bergner, Helmholtz-Zentrum Dresden-Rossendorf, Germany
6. **Deformation behavior of miniaturized copper bicrystals and corresponding dislocation boundary interactions**
Peter J. Imrich, Austrian Academy of Sciences, Austria
7. **Mechanical behavior of reaction wood: A multiscale approach**
Rejin Raghavan, EMPA Materials Science and Technology, Switzerland
8. **Preparation and characterization of aluminum - fullerene composite**
Vladimir V. Milyavskiy, Joint Institute for High Temperatures of RAS, Russia
9. **In situ evaluation of pile-ups height during scratch hardness test**
Alex Useinov, Technological Institute for Superhard and Novel Carbon Materials, Russia
10. **Mechanical properties, structure and shock behavior of yttria-doped tetragonal zirconia**
Vladimir V. Milyavskiy, Joint Institute for High Temperatures of RAS, Russia
11. **Electromechanical test of single-wall carbon nanotube thin film**
Won Seok Chang, Korea Institute of Machinery and Materials, Korea
12. **Investigation of the fracture of thin amorphous alumina films during spherical nanoindentation**
David Mercier, CEA-LETI Minatec, France
13. **Fracture modes in micropillar compression**
Philip R. Howie, University of Cambridge, United Kingdom
14. **Plasticity in brittle intermetallics**
William J. Clegg, University of Cambridge, United Kingdom
15. **Interaction between the indentation size effect and the Hall-Petch effect in polycrystalline zirconia**
Andy Bushby, Queen Mary University of London, United Kingdom
16. **Novel preparation methods for silver nanoparticles with precise control over size and shape**
Jignasa Solanki, S. V. National Institute of Technology, India
17. **TEM investigations of the formation of martensite during nanoindentation of an austenitic NiTi shape memory alloy**
Janine Pfetzing-Micklich, Ruhr University Bochum, Germany

18. **AFM-based indentation in KBr(100): Measurement of homogeneous dislocation nucleation in three dimensions and Time dependent plasticity**
Robert Gralla, INM - Leibniz Institute for New Materials, Germany
19. **Elastic nanoindentation experiments with mixed load and superposed mixed vibration for the determination of Young's modulus and Poisson's ratio**
Andre Clausner, Chemnitz University of Technology, Germany
20. **Hardness and elastic modulus gradients in plasma nitrided 316l polycrystalline stainless steel investigated by nanoindentation tomography**
Christoph Tromas, Université de Poitiers, France
21. **Synchrotron-based in situ mechanical testing of nanocrystalline metals and alloys**
Jochen Lohmiller, Karlsruhe Institute of Technology, Germany
22. **Mechanical properties of self-assembled nanoparticle arrays**
Anna Campbelllova, Czech Metrology Institute, Czech Republic
23. **Natural bio-ceramic nano composites, Strombus gigas conch shell: The hierarchical microstructure and the mechanical properties**
Yoon Ah Shin, Pohang University of Science and Technology, Korea
24. **Combined characterization of thin films using scanning probe microscopy and nanoindentation**
Oleg Lysenko, Institute for Superhard Materials, Ukraine
25. **Natural bio-ceramic nano-composites: The hierarchical microstructure and the mechanical properties of nacre**
Subin Lee, Pohang University of Science and Technology, Korea
26. **Dislocation plasticity of Au nanowires under strain gradient condition observed by *in-situ* TEM compression**
Jiseong Im, Pohang University of Science and Technology, Korea
27. **Modulus mapping of implant microcomposites**
Erik F.-J. Rettler, Friedrich-Schiller-University Jena, Germany
28. **Experimental determination of the effective indenter shape and epsilon factor for nanoindentation**
Benoit Merle, University Erlangen-Nürnberg, Germany
29. **Fatigue testing of gold thin films with the bulge test**
Benoit Merle, University Erlangen-Nürnberg, Germany
30. **Micro-shear deformation of fcc crystals**
Jenna-Kathrin Heyer, Ruhr-Universität Bochum, Germany
31. **Heat- and erosion-resistant nanostructured coatings for the compressor blades of gas turbine engines**
Aleksandrs Urbahs, Riga Technical University, Latvia
32. **Experimental investigation of physico-mechanical properties nanostructured ion-plasma coatings**
Margarita Urbach, Riga Technical University, Latvia
33. **A method to estimate the cone indentation hardness of materials from their rheological schemes**
Gaylord Guillonéau, LTDS Ecole Centrale de Lyon, France

34. **Local identification of the stress-strain curves of metal materials at a high strain rate using repeated micro-impact testing**
Gaylord Guillonéau, LTDS Ecole Centrale de Lyon, France
35. **Micro-tensile test of nano-thick thin film specimen fabricated by transferring process**
Bongkyun Jang, Korea Institute of Machinery & Materials, Korea
36. **Strain rate sensitivity effects on the failure of metal films on compliant substrates**
Megan J. Cordill, Austrian Academy of Sciences, Austria
37. **Adequateness of the effectively shaped indenter approach for the determination of yield strength**
Frank Richter, Chemnitz University of Technology, Germany
38. **Preparation of novel polyimide nanofoams and investigation of their physical and mechanical properties**
Elham Aram, Iran Polymer and Petrochemical Institute, Iran
39. **Direct measurement of contact area during spherical indentation of viscoelastic polymers**
Andy Bushby, Queen Mary University of London, United Kingdom
40. **Determining real indenter geometry in spherical nanoindentation taking into account infinitesimal deformation of the indenter**
Young-Cheon Kim, Seoul National University, Korea
41. **Nanoindentation testing of Ti6Al4V nanolayers modified by ion beam Methods**
Frantisek Cerny, CTU in Prague, Czech Republic
42. **Influence of pre-existing dislocations on the pop-in phenomenon during nanoindentation in MgO**
Christoph Tromas, Université de Poitiers, France
43. **Fracture testing – from the microscale to macroscale**
David E.J. Armstrong, University of Oxford, United Kingdom
44. **Micro-cantilever tests of strengthening from α/α and α/β boundaries in titanium alloys**
Jicheng Gong, University of Oxford, United Kingdom
45. **Nanoindentation study of homo-epitaxied 4H-SiC single crystals: the effect of doping**
Jacques Rabier, Université de Poitiers, France
46. **Effect of in situ hydrogen charging on the pulsed plasma nitiding layer in stainless steels**
Afrooz Barnoush, Saarland University, Germany
47. **Direct evaluation of dislocation networks and dislocation density tensors from atomistic data**
Christoph Begau, Ruhr-University Bochum, Germany
48. **Onset of plasticity in silicon nanowires**
Ludovic Thilly, Université de Poitiers, France
49. **Deformation analysis of vertically aligned carbon nanotube bundles under uniaxial compression**
Shelby B. Hutchens, California Institute of Technology, USA
50. **Micromechanical testing of stress corrosion cracking behaviour at individual Grain boundaries in stainless steel**
Alisa Stratulat, University of Oxford, United Kingdom

51. **Investigation of the size dependent mechanical behavior of α -FE and non-alloyed DC04 steel**
Simone Schendel, Karlsruhe Institute of Technology, Germany
52. **Effect of specimen size on the tensile strength of WC-Co hard metal**
Thomas Klünsner, Materials Center Leoben Forschung GmbH, Austria
53. **Observation of dislocation-movement in passivated Al film using in situ transmission electron microscopy nanoindentation**
Ludvig de Knoop, CEMES-CNRS, France
54. **3D-Experimental study of the formation of slip bands near boundaries in bicrystals with small dimension**
Afrooz Barnoush, Saarland University, Germany