

Program

Nanomechanical Testing in Materials Research and Development IX

October 6-11, 2024

Giardini Naxos, Messina
Sicily, Italy

Conference Chair

Marco Sebastiani, Università degli studi Roma Tre, Italy



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Previous conferences in this series

Instrumented Indentation Testing in Materials Research & Development

October 9 – 15, 2005

Crete, Greece

Conference Chairs:

George M. Pharr, University of Tennessee, USA

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Nanomechanical Testing in Materials Research & Development II

October 11 - 16, 2009

Barga, Italy

Conference Chair:

Mathias Göken, University Erlangen-Nurnberg, Germany

Nanomechanical Testing in Materials Research & Development III

October 9 – 14, 2011

Lanzarote, Canary Islands, Spain

Conference Chair:

Gerhard Dehm, University of Leoben, Austria

Nanomechanical Testing in Materials Research & Development IV

October 6 - 11, 2013

Albufeira, Portugal

Conference Chair:

Johann Michler, EMPA, Switzerland

Nanomechanical Testing in Materials Research & Development V

October 4-9, 2015

Albufeira, Portugal

Conference Chair:

Marc Legros, CEMES-CNRS, France

Nanomechanical Testing in Materials Research & Development VI

October 1-6, 2017

Dubrovnik, Croatia

Conference Chair:

Karsten Durst, Technical University of Darmstadt, Germany

Nanomechanical Testing in Materials Research & Development VII

September 29 – October 4, 2019

Torremolinos/Malaga, Spain

Conference Chair:

Jon Molina-Aldareguia, IMDEA Materials Institute, Spain

Previous conferences in this series

Nanomechanical Testing in Materials Research & Development VIII

October 2-7, 2022

Split, Croatia

Conference Chair:

Sandra Korte-Kerzel, RWTH Aachen University, Germany

Sunday, October 6, 2024

- 09:30 – 10:00 Check-in for Optional Tutorial Session ([UNA Hotel Lobby](#))
- 10:00 – 13:00 **MecaNano Tutorial Session** ([Congress Center](#))
- Nanomechanical testing: A lot more than simple small-scale testing - advances and challenges**
Verena Maier-Kiener, Montanuniversität Leoben, Leoben, Austria
- Advanced nanomechanical testing protocols: High-speed nanoindentation and machine learning for big data analysis**
Edoardo Rossi, Università degli studi Roma Tre, Rome, Italy
- 13:00 - 14:30 Lunch on your own
- 14:30 – 15:45 Conference Check-In ([UNA Hotel Lobby](#))
- 15:45 – 16:00 Conference Welcome Remarks ([Congress Center](#))
- 16:00 – 16:50 **Plenary Talk 1**
Three-dimensional interfaces in metallic nanolaminates
Irene J. Beyerlein, University of California, Santa Barbara, USA
- Session 1A**
Novel nanoindentation and nanomechanical testing methods
Moderator: Prof. Sandra Korte-Kerzel, RWTH Aachen University, Germany
- 16:50 – 17:10 **Spherical nanoindentation – A further step towards accelerated materials development**
Verena Maier-Kiener, Montanuniversität Leoben, Austria
- 17:10 – 17:30 **A framework for nanoindentation of soft biomaterials and polymers**
Donna M. Ebenstein, Biomedical Engineering Department, Bucknell University, Lewisburg, USA
- 17:30 – 17:50 **Updated HTSI method: Characterizing CaF₂ properties from RT to 800°C**
Gabrielle Tiphéne, IMAP, IMMC, UCLouvain, Louvain-la-Neuve, Belgium
- 17:50 – 18:10 **Lateral nanoindentation: Energy dissipation and static friction**
John B. Pethica, Trinity College Dublin, Ireland
- 18:10 – 18:30 **Insights into the origins of friction from two-axis nanoindentation**
George M. Pharr, Department of Materials Science and Engineering, Texas A&M University, Texas, USA
- 19:00 – 21:30 Opening reception ([Garden](#)) and dinner (Buffet in [Oasys Restaurant-ECI reserved section](#))

Monday, October 7, 2024

07:00 – 08:30

Breakfast buffet ([Oasys Restaurant](#))

Session 1B

Novel nanoindentation and nanomechanical testing methods

Moderator: Prof. Karsten Durst, TU Darmstadt, Germany

08:30 – 09:00

Invited Talk

High strain rate nanoindentation testing: recent advancements, challenges, and opportunities

Sudharshan Phani Pardhasaradhi, ARCI, Hyderabad, India

09:00 – 09:20

A new controller specifically designed for very high speed nanoindentation

Warren Oliver, KLA Corporation, Instruments group, Oak Ridge, USA

09:20 – 09:40

Slip statistics from high-data-acquisition rate nanoindentation of a metallic glass

Wendelin J. Wright, Bucknell University, Lewisburg, Pennsylvania, USA

09:40 – 10:00

Constant Strain Rate Nanoindentation up to 10,000/s Strain Rate for Reliable Extraction of Mechanical Properties and Deformation Activation Parameters

Gaurav Mohanty, Materials Science and Environmental Engineering, Tampere University, Finland

10:00 – 10:20

Strategies to mitigate the effect of FIB damage during micro fracture testing

Christoph Kirchlechner, Institute for Applied Materials, Karlsruhe Institute of Technology, Karlsruhe, Germany

10:20 – 10:50

Coffee break ([Olympic pool terrace](#))

10:50 – 11:00

Communications for the day

Session 2A

Multiscale deformation mechanisms (from atomic to meso-scale)

Moderator: Graham Cross, Trinity College Dublin, Ireland

11:00 – 11:30

Invited Talk

Nanomechanics serving polymer-based composite research

Thomas Pardoën, Institute of Mechanics, Materials and Civil Engineering (IMMC), UC Louvain, Belgium and WEL Research Institute, Belgium

11:30 – 11:50

Solute effects on the migration of a single twin boundary in magnesium

Henry Ovri, Helmholtz-Zentrum Hereon, Institute of Materials Mechanics, Geesthacht, Germany

11:50 – 12:10

Nanoindentation study at single grain boundaries of oxide ceramics

Hiroshi Masuda, The University of Tokyo, Japan

12:10 – 12:30

Room-temperature multiscale dislocation plasticity in oxides

Xufei Fang, Institute for Applied Materials, KIT, Karlsruhe, Germany

Monday, October 27, 2024 (continued)

- 12:30 – 13:00 **Invited Talk**
Developing multiscale toughened ceramics: the role of nano- and micromechanical testing
Diletta Giuntini, Dept. of Mechanical Engineering, Eindhoven University of Technology, Eindhoven, The Netherlands
- 13:00 – 14:30 Lunch buffet
- 14:30 – 15:30 Networking time
- Session 3A - In-situ and operando nanomechanics**
Moderator: Prof. Christoph Kirchlechner, Karlsruhe Institute of Technology, Germany
- 15:30 – 16:00 **Invited Talk**
Dislocation pathways in and interstitial engineering of BCC refractory multi-principal element alloys
Daniel S. Gianola, Materials Department, University of California Santa Barbara, USA
- 16:00 – 16:20 **Investigation of the deformation mechanisms of MoS₂ fullerenes by in situ mechanical tests in environmental transmission electron microscopy**
Karine Masenelli-Varlot, INSA Lyon, Universite Claude Bernard Lyon 1, CNRS, MATEIS, UMR5510, Villeurbanne, France
- 16:20 – 16:40 **Martensitic transformation in Ce-doped zirconia: In-situ X-ray diffraction during mechanical testing or annealing on synchrotron beamlines**
Marcelo D. Magalhães, INSA Lyon – MATEIS, Villeurbanne, France
- 16:40 – 17:00 **Physical, chemical and architectural metal-ceramic nanolaminate design for enhanced mechanical Properties**
Xavier Maeder, Empa, Swiss Federal Laboratories for Materials Science and Technology, Thun, Switzerland
- 17:00 – 17:30 **Invited Talk**
Micro- and nanomechanical in situ experiments to address fracture processes
Daniel Kiener, Montanuniversität Leoben, Austria
- 17:30 – 18:00 Coffee break
- 18:00 – 19:15 **Poster Preview Session (odd-numbered posters)**
Moderators: Prof. Verena Maier-Kiener and Prof. Benoit Merle (one minute each speaker)
- 19:15 – 21:00 Buffet dinner
- 21:00 – 23:00 Poster session with social time

Tuesday, October 8, 2024

07:00 – 08:30

Breakfast buffet

Session 4A - Nanomechanics in extreme conditions

Moderator: Prof. Verena Maier-Kiener, Montanuniversität Leoben, Austria

08:30 – 09:00

Invited Talk

Nanoindentation tests for understanding the effect of light environment on dislocations behavior in compound semiconductors

Atsutomo Nakamura, Department of Mechanical Science and Bioengineering, Graduate School of Engineering Science, Osaka University, Japan

09:00 – 09:20

From heat to hardness: Probing phase changes in pd-based alloy with high-temperature nanoindentation

Lea A. Lumpfer, Montanuniversität Leoben, Leoben, Austria

09:20 – 09:40

Electron irradiation induced crack suppression in oxide glasses

Sebastian Bruns, Physical Metallurgy, Technical University of Darmstadt, Darmstadt, Germany

09:40 – 10:00

Microscale additively manufactured 3D metal-ceramic nanocomposites with improved strength and thermal stability

Jakob Schwiedrzik, Laboratory for Mechanics of Materials and Nanostructures, Empa, Switzerland

10:00 – 10:20

In-situ environmental TEM study of the effect of hydrogen on crack propagation in steel

Lin Tian, Institute of Materials Physics, University of Göttingen, Germany

10:20 – 10:50

Coffee break

10:50 – 11:00

Communications for the day

Session 4B - Nanomechanics in extreme conditions

Moderator: Prof. Erik G. Herbert, Oak Ridge National Labs, USA

11:00 – 11:30

Invited Talk

High strain rate persistence of the strength anomaly in a L12 intermetallic compound evidenced by nanoindentation at combined high strain rates and high temperatures

Benoit Merle, Institute of Materials Engineering, University of Kassel, Germany

11:30 – 11:50

What can we expect from high strain rate micropillar compression of metals at the grain scale?

Guillaume Kermouche, Mines Saint-Etienne, Laboratoire Georges Friedel, CNRS UMR 5307, France

11:50 – 12:10

High strain rate nanoindentation of fused silica, silicon, and nanocrystalline nickel

Lalith Kumar Bhaskar, Max-Planck-Institut für Nachhaltige Materialien GmbH, Germany

Tuesday, October 8, 2024 (continued)

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| 12:10 – 12:30 | A new approach for in-situ electrochemical nanoindentation: side charging as a promising alternative Stefan Zeiler, Department of Materials Science, Montanuniversität Leoben, Leoben, Austria |
| 12:30 – 13:00 | <u>Invited Talk</u> Uncovering extreme dynamic responses in microscale mechanical metamaterials Carlos M. Portela, Department of Mechanical Engineering, MIT, USA |
| 13:00 – 14:30 | Lunch buffet |
| 14:45 – 15:00 | Board buses for excursion |
| 15:00 – 22:30 | Excursion to Taormina (guided tour including dinner) |

Wednesday, October 9, 2024

07:00 – 08:30

Breakfast buffet

Session 2B

Multiscale deformation mechanisms (from atomic to meso scale)

Moderator: Prof. Ralph Spolenak, ETH Zurich, Switzerland

08:30 – 09:20

Plenary Talk 2

Effects of grain boundary structure and chemistry on plasticity in metals

Gerhard Dehm, MPI for Sustainable Materials, Düsseldorf, Germany

09:20 – 09:40

Relationship between sliding direction and crystal rotation under tribological loading

Christian Greiner, Institute for Applied Materials (IAM), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

09:40 – 10:00

Mechanical response of varying non-equilibrium grain boundary states in nanocrystalline iron-chromium

Markus Alfreider, Department Materials Science, Montanuniversität Leoben, Leoben, Austria

10:00 – 10:20

Shear induced amorphization: A new deformation mechanism for silicates

Patrick Cordier, University of Lille, Lille, France and Institut Universitaire de France, Paris, France

10:20 – 10:50

Coffee break

10:50 – 11:00

Communications for the day

Session 5A

Complex strain measurement methods and advanced data analysis

Moderator: Prof. Wendy Wright

11:00 – 11:30

Invited Talk

From the study of plastic strain localization to the study of discrete localized plastic deformation events in metals

Jean-Charles Stinville, Materials Science and Engineering Department, University of Illinois at Urbana-Champaign, USA

11:30 – 11:50

Evolution of nanoscopic stress and strain concentrations across notched microcantilevers during in situ bending

Michael Meindlhumer, Department Materials Science, Montanuniversität Leoben, Leoben, Austria

11:50 – 12:10

Micromechanics of thin films with digital image correlation: Three case studies

Oleksandr Glushko, Department of Materials Science, Montanuniversität Leoben, Leoben, Austria

12:10 – 12:30

Advanced TEM techniques for measuring nanoscale stress fields during micromechanical testing of non-equilibrium materials

Christoph Gammer, Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Austria

Wednesday, October 9, 2024 (continued)

- 12:30 – 13:00 **Invited Talk**
Process-structure-property relationship in 3D printed metals
Steven Van Petegem, Photon Science Division, Paul Scherrer Institute,
Forschungsstrasse, Switzerland
- 13:00 – 14:30 Lunch buffet
- 14:30 – 15:30 Networking time
- Session 6A**
Integrated modelling and characterization
Moderator: Prof. Nate Mara, UMN-CSE - University of Minnesota, USA
- 15:30 – 16:00 **Invited Talk**
Solute strengthening in FCC High Entropy Alloys: From modeling to alloy design
Céline Varvenne, MatéIS, INSA Lyon, France
- 16:00 – 16:20 **Relating the distribution of stochastic nanomechanical properties to microstructural mechanisms using molecular dynamics simulations**
Dan Mordehai, Faculty of Mechanical Engineering, Technion, Israel
- 16:20 – 16:40 **The effect of twin boundaries on nucleation-controlled plasticity of metal nanoparticles**
Eugen Rabkin, Department of Materials Science and Engineering, Technion, Haifa, Israel
- 16:40 – 17:00 **Finite element and microplane Modelling of WC-Co composites based on tomography meshes, nanoindentation and microsample testing**
Emilio Jiménez-Piqué, Universitat Politècnica de Catalunya, Campus Diagonal Besòs, Edifici A (EEBE) Barcelona, Spain
- 17:00 – 17:30 **Invited Talk**
Unraveling the origins of fracture toughness by integrating micromechanical testing and atomistic simulations
Erik Bitzek, Max Planck Institute for Sustainable Materials, Germany
- 17:30 – 18:00 Coffee break
- 18:00 – 19:15 **Poster Preview Session (even-numbered posters)**
Moderators: Prof. Verena Maier-Kiener and Prof. Benoit Merle (one minute each speaker)
- 19:15 – 21:00 Buffet dinner
- 21:00 – 23:00 Poster session with social time

Thursday, October 10, 2024

07:00 – 08:30

Breakfast buffet

Session 8A

Correlative mechanical microscopy

Moderator: Prof. Guillaume Kermouche, Ecole des Mines de Saint-Etienne, France

08:30 – 09:00

Invited Talk

Operando correlative mechanical microscopy

Jeffrey M. Wheeler, Femto Tools AG and ETH Zurich, Switzerland

09:00 – 09:20

Oxygen, a strengthening and embrittling element for titanium inherited from high temperature oxidation: A multimodal framework using high speed nanoindentation mapping and micropillar compression

Damien Texier, Institut Clément Ader (ICA), CNRS, Albi, France

09:20 – 09:40

Atomic scale characterization of deformation and fracture phenomena using a MEMS-based in situ STEM loading system

Eita Tochigi, Institute of Industrial Science, University of Tokyo, Japan

09:40 – 10:00

In situ micromechanical characterization of multi-layered thin films: Strain rate, size and microstructure related experiments

Szilvia Kalácska, CNRS LGF, Mines St. Etienne, France

10:00 – 10:30

Invited Talk

Physical micrometallurgy: Localized electrodeposition based additive approach

Rajaprakash Ramachandramoorthy, Max-Planck-Institut für Nachhaltige Materialien GmbH, Düsseldorf, Germany

10:30 – 11:00

Coffee break

Session 9A

Application of nanomechanics to industrially relevant materials and devices

Moderator: Prof. Damien Texier, Institut Clément Ader, CNRS, France

11:00 – 11:30

Invited Talk

In situ tensile testing of nanocomposite thin films on flexible polymer substrates

Barbara Putz, Empa, Thun, Switzerland

11:30 – 11:50

Insights into micropillar compression during hydrogen charging

Maria Jazmin Duarte Correa, Max-Planck-Institut für Nachhaltige Materialien GmbH, Germany

11:50 – 12:10

In situ electrical resistance in metallic films under cyclic loading reveals mechanical damage mechanisms

Megan J. Cordill, Erich Schmid Institute of Materials Science, Austrian Academy of Sciences Leoben, Austria

12:10 – 12:30

Local Deformation Along the Iron Ore Reduction Cascade

James P. Best, Max-Planck-Institut für Nachhaltige Materialien GmbH, Germany

12:30 – 12:50

Deciphering the puzzle of plastic deformation in cubic c15 laves phases: Surprising insights and future paths

Sandra Korte-Kerzel, Institut für Metallkunde und Materialphysik, RWTH Aachen University, Germany

Thursday, October 10, 2024 (continued)

12:50 – 14:30 Lunch buffet

14:30 – 15:30 Networking Time

Session 7A

Artificial Intelligence for nanomechanics

Moderator: Prof. Edoardo Bemporad

15:30 – 16:00

Invited Talk

Artificial Intelligence for micro- and nanomechanics

Ulrich Kerzel, RWTH Aachen University

16:00 – 16:20

Combinatorial and high-throughput discovery of metal alloy thin films with outstanding mechanical properties

Johann Michler, Empa, Swiss Federal Laboratories for Materials Science and Technology, Thun, Switzerland

16:20 – 16:40

Employing grain boundary segregation engineering for improved mechanical performance of nanostructured tungsten

Julius F. Keckes, Department Materials Science, Chair of Materials Physics, Montanuniversität Leoben, Austria

16:40 – 17:10

Invited Talk

Combinatorial and high-throughput investigation of nanoindentation techniques in the era of AI

Andrea M. Hodge, University of Southern California, USA

17:10 – 17:40

Coffee Break

Session 9B

Application of nanomechanics to industrially relevant materials and devices

Moderator: Prof. Megan J. Cordill, Erich Schmid Institute of Materials Science, Austrian Academy of Sciences Leoben, Austria

17:40 – 18:50

High throughput assessment of creep behavior of advanced nuclear reactor alloys by nanoindentation

Nathan A. Mara, University of Minnesota-Twin Cities, USA

18:00 – 18:20

Tailoring microstructural heterogeneities in thin film metallic glasses and crystal/glass ultra-fine nanolaminates to enhance their mechanical properties

Matteo Ghidelli, Laboratoire des Sciences des Procédés et des Matériaux (LSPM), CNRS, France

18:20 – 18:40

Investigating enhancements in fracture reliability of 3D-printed micro-ceramics via ALD coatings

Edoardo Rossi, Department of Civil, Computer Science and Aeronautical Technologies Engineering, Rome Tre University, Italy

18:40 – 19:00

The mechanics of solid-state battery materials: The hidden surprise of lithium metal and amorphous separators

Erik G. Herbert, Oak Ridge National Laboratory, TN, USA

20:00 – 22:30

Conference Banquet