IUTAM

International Union of Theoretical and Applied Mechanics

# SYMPOSIUM PROGRAMME

## IUTAM Symposium on Enhancing Material Performance by Exploiting Instabilities and Damage Evolution

June 5–10, 2022
Warsaw, Poland

IUTAM Symposium on

# Enhancing Material Performance by Exploiting Instabilities and Damage Evolution

## SYMPOSIUM PROGRAMME


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Warsaw, Poland

## Symposium Chair and Organizer

**Katarzyna Kowalczyk-Gajewska** Institute of Fundamental Technological Research of Polish Academy of Sciences (IPPT PAN), Warsaw, Poland

## Symposium Co-Chair and Co-Organizer

**Ankit Srivastava** Texas A&M University, College Station, USA

## Scientific Committee

**Vikram Deshpande** Cambridge University, UK

**Yonggang Huang** Northwestern University, USA

**Dennis Kochmann** ETH Zurich, Switzerland

**Katarzyna Kowalczyk-Gajewska** IPPT PAN, Poland (Chair)

**Mitsutoshi Kuroda** Yamagata University, Japan

**Alan Needleman** Texas A&M University, USA

**Henryk Petryk** IPPT PAN, Poland (IUTAM Representative)

**Ankit Srivastava** Texas A&M University, USA (Co-Chair)

## Local Organizing Committee

**Michał Kursa** IPPT PAN, Warsaw, Poland

**Karol Frydrych** IPPT PAN, Warsaw, Poland

**Michał Majewski** IPPT PAN, Warsaw, Poland

iutam2022@ippt.pan.pl

## Symposium Website

iutam2022warsaw.ippt.pan.pl

# Symposium Venue

The IUTAM Symposium will be held at the Institute of Fundamental Technological Research Polish Academy of Sciences (IPPT PAN) in Warsaw, Poland.
The IPPT building is located at the Ochota Campus, Pawińskiego 5B
ippt.pan.pl

# Social Events

## Monday, June 6, 17:30

**Welcome Reception**
Lobby of the IPPT building

## Tuesday, June 7, 19:00

**Symposium Dinner**
Vistula Boulevards of Jan Karski
Restaurant Barka Warszawska Dzień i Noc
barkawarszawska.pl

## Thursday, June 9, 18:30

**Museum Tour and Banquet Dinner**
Kotlownia of Polish Vodka Museum
Koneser Centre of Praga district, Plac Konesera 1
muzeumpolskiejwodki.pl

# Programme Overview

| Sunday<br>June 5, 2022 | Monday<br>June 6, 2022 | Tuesday<br>June 7, 2022 | Wednesday<br>June 8, 2022 | Thursday<br>June 9, 2022 | Friday<br>June 10, 2022 |
|---|---|---|---|---|---|
| | | 8:30–9:30<br>Breakfast | 8:30–9:30<br>Breakfast | 8:30–9:30<br>Breakfast | |
| | 9:00–11:00<br>Registration | 9:30–11:15<br>Session 04 | 9:30–11:15<br>Session 08 | 9:30–11:15<br>Session 12 | |
| | 11:00–11:35<br>Opening<br>Session | Coffee Break | Coffee Break | Coffee Break | |
| | 11:35–12:45<br>Session 01 | 11:35–12:45<br>Session 05 | 11:35–12:45<br>Session 09 | 11:35–12:45<br>Session 13 | |
| | 12:45–14:00<br>Lunch | 12:45–14:00<br>Lunch | 12:45–14:00<br>Lunch | 12:45–14:00<br>Lunch | |
| Open day | 14:00–15:10<br>Session 02 | 14:00–15:10<br>Session 06 | 14:00–15:10<br>Session 10 | 14:00–15:10<br>Session 14 | Open day |
| | Coffee Break | Coffee Break | Coffee Break | Coffee Break | |
| | 15:30–17:15<br>Session 03 | 15:30–16:40<br>Session 07 | 15:30–16:40<br>Session 11 | 15:30–16:40<br>Session 15 | |
| | | | | | |
| | 17:30–20:00<br>Poster<br>Session<br>and<br>Welcome<br>Reception | 19:00<br>Symposium<br>Dinner* | | 18:30–23:00<br>Museum<br>Tour<br>and<br>Banquet<br>Dinner* | |

The registration desk will be open in the lobby of the IPPT building.
All sessions will be in room Aula on the second floor of the IPPT.
*not included in the student fee.

# Detailed Technical Programme

**Monday, June 6, 2022**

| | |
|---|---|
| 9:00–11:00 | Registration<br>Coffee will be served from 10:00 |
| 11:00–11:35 | Opening Session |
| | **11:35–12:45 Session 01** **Chair: J.A. Rodríguez-Martínez** |
| 11:35–12:10 | **G. Subhash** and A.A. Cheenady – Shock-Induced Spallation in Monocrystalline Boron Carbide |
| 12:10–12:45 | **S.M. Keralavarma** – Constitutive Effects on Failure by Strain Localization in Ductile Materials |
| 12:45–14:00 | Lunch |
| | **14:00–15:10 Session 02** **Chair: B. Revil-Baudard** |
| 14:00–14:35 | B. Schroeders, T. Oudes, O. Rokoš, **R. Peerlings**, M. Geers, O. Faltus, M. Horák, M. Doškář, M. Jirásek and J. Zeman – Harnessing Microscale Buckling Instabilities to Control Macroscale Stiffness |
| 14:35–15:10 | P. Taylor, J. Londono, **P.B. Woelke** and J.W. Hutchinson – Investigation of Effect of Plate Thickness on Ductility for Engineering Applications |
| 15:10–15:30 | Coffee Break |
| | **15:30–17:15 Session 03** **Chair: K.L. Nielsen** |
| 15:30–16:05 | M. Rezaee-Hajidehi, P. Sadowski and **S. Stupkiewicz** – Phase-Field Model for Spatially Resolved Deformation Twinning Coupled with Crystal Plasticity |
| 16:05–16:40 | N. Hosseini, J.C. Nieto-Fuentes, M. Dakshinamurthy, J.A. Rodríguez-Martínez and **G. Vadillo** – The Effect of Material Orientation on Void Growth |
| 16:40–17:15 | **O. Cazacu** and B. Revil-Baudard – Size of the Plastic Zone Near a Crack: New Exact Solutions |
| | |
| 17:30–20:00 | Poster Session and Welcome Reception |

**Monday, June 6, 2022**

| Poster Session | |
|---|---|
| 17:30–20:00<br>IPPT<br>building<br>lobby | **J. Dobrzański**, K. Wojtacki and S. Stupkiewicz – Lamination-Based Efficient Treatment of Weak Discontinuities for Non-Conforming Finite-Element Meshes<br><br>**V.P. Dubey**, M. Kopec and Z.L. Kowalewski – The Effect of Predeformation History Under Complex Loading on the Yield Surface Evolution of Titanium Alloy: An Experimental Investigation<br><br>**K. Frydrych** and S. Papanikolaou – Structure-Based Optimization of Crystal Plasticity Parameters in Metals and Alloys<br><br>**M. Majewski**, M. Wichrowski, P. Hołobut and K. Kowalczyk-Gajewska – Micromechanical and Numerical Analysis of Shape and Packing Effects in Elastic-Plastic Particulate Composites<br><br>**S. Musiał**, M. Maj, L. Urbański and M. Nowak – Field Analysis of Energy Conversion During Plastic Deformation Process<br><br>**M. Nabavian Kalat**, M. Staszczak, Y. Ziai, L. Urbański and E. Pieczyska – Effect of Shape Recovery and Cyclic Loading on the Evolution of Micro-Cracks in Shape Memory Polymers<br><br>**M. Rezaee-Hajidehi**, K. Tůma and S. Stupkiewicz – Stress-Induced Martensitic Transformation in Shape Memory Alloys During Nano-Indentation: Insights From Phase-Field Simulations<br><br>**M. Ryś**, S. Stupkiewicz and H. Petryk – Gradient-Enhanced Crystal Plasticity Model with Micropolar Regularization: Prediction of the Indentation Size Effects<br><br>**S. Virupakshi**, K. Frydrych and K. Kowalczyk-Gajewska – Effect of Boundary Conditions and Crystallographic Orientation on the Cylindrical Void Growth in FCC Single Crystals Using CPFEM |

## Tuesday, June 7, 2022

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| 8:30–9:30 | Breakfast |
| | **9:30–11:15 Session 04** — **Chair: R. Zhao** |
| 9:30–10:05 | **C. Combescure** – Prediction of Instabilities in Periodic Architected Materials to Actively Modify Wave Propagation Properties |
| 10:05–10:40 | **J.J. Rimoli** and J.A. Kraus – Discontinuous Compression Structures: From Tensegrity Planetary Landers to High-Performing Metamaterials |
| 10:40–11:15 | **A.F. Arrieta** – Multistable Metastructures From Local Bistable Units: Actuation Simplification and Information Processing |
| 11:15–11:35 | Coffee Break |
| | **11:35–12:45 Session 05** — **Chair: C. Czarnota** |
| 11:35–12:10 | **T. Cohen** – Nonlinear Inclusion Theory with Application to the Growth and Morphogenesis of a Confined Body |
| 12:10–12:45 | **W. Sumelka** and P. Stempin – On Selected Space-Fractional Structural Models |
| 12:45–14:00 | Lunch |
| | **14:00–15:10 Session 06** — **Chair: N. Lu** |
| 14:00–14:35 | **V.S. Deshpande** – Micro-Architected Solids: Does Toughness Characterise Fracture? |
| 14:35–15:10 | **S. Gaitanaros** – Strength and Toughness of Lattice Materials |
| 15:10–15:30 | Coffee Break |
| | **15:30–16:40 Session 07** — **Chair: R. Peerlings** |
| 15:30–16:05 | **A.A. Benzerga** – On the Effects of the Third Stress Invariant in Ductile Failure |
| 16:05–16:40 | **H. Petryk** – Path Instability Criterion for Non-Potential Problems in Rate-Independent Plasticity |

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| 19:00 | Symposium Dinner* |

*not included in the student fee.

## Wednesday, June 8, 2022

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| 8:30–9:30 | Breakfast |
| | **9:30–11:15 Session 08** — **Chair: C. Combescure** |
| 9:30–10:05 | **N. Lu** – Poking and Bulging of 2D Crystals |
| 10:05–10:40 | **R. Zhao** – Functional Buckling and Folding of Ring Origami |
| 10:40–11:15 | **S. Basu** – Sensitivity of Very Soft Solids to Stimuli and Surface Effects |
| 11:15–11:35 | Coffee Break |
| | **11:35–12:45 Session 09** — **Chair: T. Cohen** |
| 11:35–12:10 | **W.A. Curtin** – Exploiting the Randomness of High Entropy Alloys |
| 12:10–12:45 | **M.J. Demkowicz** – The Effect of Hydrogen on Localized Plasticity and Crack Initiation in Nickel-Base Alloy 725 |
| 12:45–14:00 | Lunch |
| | **14:00–15:10 Session 10** — **Chair: S.M. Keralavarma** |
| 14:00–14:35 | J. Xie and **K. Ravi-Chandar** – Exploration of Ductile Failure Processes in an Aluminum Alloy Through X-Ray CT Scan and Microscopy |
| 14:35–15:10 | **M. Radovic** and A. Srivastava – Enhancing Damage Tolerance and Crack Healing in Ceramics by Kinking: The Case of MAX Phases |
| 15:10–15:30 | Coffee Break |
| | **15:30–16:40 Session 11** — **Chair: A.F. Arrieta** |
| 15:30–16:05 | **W.J. Meng**, X. Zhang, B. Zhang, A.C. Meng, R. Namakian, D. Moldovan and K.L. Nielsen – Understanding Mechanical Integrity of Metal/Ceramic Interfacial Regions and Mechanical Response of Plastic Deformation at the Micro/Meso Scales |
| 16:05–16:40 | **S. Osovski** and S. Tsopanidis – Extracting Grain Boundary Toughness from Macro-Scale Experiments |

## Thursday, June 9, 2022

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|---|---|
| 8:30–9:30 | Breakfast |
| | **9:30–11:15 Session 12** — **Chair: S. Stupkiewicz** |
| 9:30–10:05 | **S. Forest**, J.-M. Scherer, V. Phalke and J. Besson – Grain Boundaries as Barriers Against Shear Banding and Crack Propagation in Ductile Polycrystals: A Gradient Crystal Plasticity Approach |
| 10:05–10:40 | **K.L. Nielsen**, J.E. Simon, R.G. Andersen and C. Tekoglu – Plate Bending: Localization and Fracture Triggered by Heterogeneities |
| 10:40–11:15 | **J.A. Rodríguez-Martínez** – The Effect of Actual Porous Microstructure on the Formation of Dynamic Necks, Adiabatic Shear Bands and Plastic Shock Waves |
| 11:15–11:35 | Coffee Break |
| | **11:35–12:45 Session 13** — **Chair: S. Gaitanaros** |
| 11:35–12:10 | **C.F. Niordson** – On Effects of Void Clustering on Yield Surfaces |
| 12:10–12:45 | E. Chiu, **A. Needleman**, S. Osovski and A. Srivastava – Mitigating Spall Fracture of Ductile Materials by Introducing Porosity |
| 12:45–14:00 | Lunch |
| | **14:00–15:10 Session 14** — **Chair: S. Basu** |
| 14:00–14:35 | **C. Czarnota**, A. Molinari and S. Mercier – Steady Shock Wave in Porous Metals: Visous & Micro-Inertia Effects Interplay |
| 14:35–15:10 | **B. Revil-Baudard** – Multi-Scale Modeling of Energetic Materials Under High Strain Rate Loadings |
| 15:10–15:30 | Coffee Break |
| | **15:30–16:40 Session 15** — **Chair: G. Vadillo** |
| 15:30–16:05 | **K. Kowalczyk-Gajewska** and S. Virupakshi – Evolution of Lattice Orientation Heterogeneity in HCP Single Crystals Due to Void Growth |
| 16:05–16:40 | **A. Srivastava** – Defects, Crack Path and Crack Growth Resistance |

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|---|---|
| 18:30–23:00 | Museum Tour<br>and<br>Banquet Dinner* |

*not included in the student fee.

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