

SYMPOSIUM CM5

Mechanically Coupled Properties, Phenomena and Testing
Methods in Small-Scale and Low-Dimensional Systems
April 18 - April 20, 2017

Symposium Organizers

Steven Boles, The Hong Kong Polytechnic University
In-Suk Choi, Korea Institute of Science and Technology
Christoph Eberl, Fraunhofer Institute for Mechanics of Materials
Hang Yu, Virginia Polytechnic Institute and State University

Symposium Support

Hong Kong Polytechnic University

Proceedings Statement

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* Invited Paper

SESSION CM5.1: Strain-Coupling in Ferroelectric Materials
Session Chairs: Steven Boles and C. A. Ross
Tuesday Morning, April 18, 2017
PCC North, 100 Level, Room 126 B

10:30 AM *CM5.1.01

Self-Assembled Nanocomposite Oxide Films—Strain Coupling, Magnetoelectricity and Phonon Transport [C. A. Ross](#); Massachusetts Institute of Technology, United States.

11:00 AM CM5.1.02

Multiferroic and Magnetolectric Architected Oxide Film [Yanxi Li](#); Virginia Tech, United States.

11:15 AM CM5.1.03

Stress-Tuning of Functional Properties of Polycrystalline Piezoelectric and Ferroelectric Thin Films [Angus I. Kingon](#); Brown University, United States.

11:30 AM CM5.1.04

Science and Technology of Interface-Engineered BiFeO₃/SrTiO₃/BiFeO₃ Nanolaminates with High Piezoelectricity and Low Leakage for Multifunctional and Biomedical MEMS/NEMS Devices [Orlando Auciello](#); University of Texas at Dallas, United States.

11:45 AM CM5.1.05

Nanodomain Engineering in Ferroelectric Capacitors with Graphene Electrodes [Haidong Lu](#); University of Nebraska–Lincoln, United States.

SESSION CM5.2: Piezoactive Materials and Applications
Session Chairs: Chang-Beom Eom and Susan Trolier-McKinstry
Tuesday Afternoon, April 18, 2017
PCC North, 100 Level, Room 126 B

1:30 PM *CM5.2.01

Giant Piezo-Driven Multiferroic Heterstructures by Design [Chang-Beom Eom](#); University of Wisconsin-Madison, United States.

2:00 PM *CM5.2.02

Piezoelectric Microelectromechanical Systems with Integrated Electronics [Susan E. Trolier-McKinstry](#); Pennsylvania State University, United States.

2:30 PM CM5.2.03

Exploiting Piezoelectrochemical Phenomena in Lithium-Ion Batteries for Low Frequency Mechanical Energy Harvesting and Storage [Craig B. Arnold](#); Princeton University, United States.

2:45 PM CM5.2.04

Direct Observation of Large Flexoelectric Bending at the Nanoscale in Lanthanide Scandates [Pratik Koirala](#); Northwestern University, United States.

3:00 PM BREAK

SESSION CM5.3: Strain-Enhancements of Thermal Transport Properties
Session Chairs: Christoph Eberl and Juejun Hu
Tuesday Afternoon, April 18, 2017
PCC North, 100 Level, Room 126 B

3:30 PM *CM5.3.01

Real-Time Probing of Strain Enhancement of Thermal Conductivity in Polyethylene Films [Austin J. Minnich](#); California Institute of Technology, United States.

4:00 PM *CM5.3.02

Elastic Strain Engineering of Semiconductor Nanostructures—The Role of Strain Gradients [Daniel S. Gianola](#); University of California Santa Barbara, United States.

4:30 PM CM5.3.03

Measurement of Nano-Scale Out-of-Plane Warpage and In-Plane Strain at Material Interfaces Using Laser Diffraction [Todd K. Houghton](#); Arizona State University, United States.

4:45 PM CM5.3.04

In Situ Mechanically Controlled Thermal Transport in 2D van der Waals' Materials [Yongjie Hu](#); University of California, Los Angeles (UCLA), United States.

SESSION CM5.4: Poster Session
Tuesday Afternoon, April 18, 2017
8:00 PM - 10:00 PM
Sheraton, Third Level, Phoenix Ballroom

CM5.4.01

Structural Characterization of Fiber Textured Au/Ti/Si Thin Films [Qiyin Lin](#); University of California, Irvine, United States.

CM5.4.02

Micromechanical Analysis of Piezoelectric—Piezomagnetic Fibrous Composites under Imperfect Contact Using Asymptotic Homogenization Method [Yoanh Espinosa Almeyda](#); Instituto de Ingeniería y Tecnología. Universidad Autónoma de Ciudad Juárez, Mexico.

CM5.4.03

Stress in Wurtzite Zinc Oxide and the Potential for Electron Device Applications [Stephen K. O'Leary](#); University of British Columbia, Canada.

CM5.4.04

Measurement of Shrinkage of 6061 Al Alloy in Casting Process [Seok Yong Seo](#); Koreatech University, Korea (the Republic of).

CM5.4.05

Mechanical Stress-Induced Switching Kinetics of Ferroelectric Thin Films at the Nanoscale [Abdullah Alsubaie](#); University of New South Wales, Australia.

CM5.4.06

Abnormal Characteristics in the Pore Formation in Graphene due to Si-Nanoparticle Bombardment [Jae Hyun Park](#); Gyeongsang National University, Korea (the Republic of).

CM5.4.07

Atomic Force Microscopy (AFM) Analysis of Adhesion and Mechanical Properties in Polydimethyl Siloxane (PDMS)-Based Systems for Nanoelectronics [Alin Cristian Chipara](#)^{1,2}; ¹Adelphi Laboratory Center, United States; ²Rice University, United States.

CM5.4.08

Nano-Mechanical Properties of Novel Oxide Nanocomposites [Treva T. Brown](#); University of New Orleans, United States.

CM5.4.09

Deformation Mechanisms in Nanocrystalline Ceramics [Xuan Zhang](#); Tsinghua University, China.

CM5.4.10

Fluorites and Perovskites with a Large Concentration of Point Defects Exhibit Large Non-Classical Electrostriction [Nimrod Yavo](#); Weizmann Inst of Science, Israel.

CM5.4.11

Elastocaloric Effect in Polycrystalline Ni-Ti-V Shape Memory Alloy [Yanghoo Kim](#); Seoul National University, Korea (the Republic of).

CM5.4.12

Quantitative Measurements of Electromechanical Response with Interferometric Atomic Force Microscopy [Aleksander Labuda](#); Asylum Research, United States.

CM5.4.13

Interfacial Mechanical Properties of Graphene on Self Assembled Monolayers—Experiments and Simulations [Qing Tu](#)^{1,2}; ¹Duke University, United States; ²Duke University, United States.

SESSION CM5.5: Shape Memory Materials
Session Chairs: Young-chang Joo and Hang Yu
Wednesday Morning, April 19, 2017
PCC North, 100 Level, Room 126 B

8:00 AM *CM5.5.01

Shape Memory Alloys at Small Scales [Ying Chen](#); Rensselaer Polytechnic Institute, United States.

8:30 AM *CM5.5.02

Highly Cyclic Superelasticity in CeO₂-ZrO₂ Shape Memory Ceramics Particles at Microscales [Chee Lip Gan](#)^{1,2}; ¹Nanyang Technological University, Singapore; ²Nanyang Technological University, Singapore.

9:00 AM CM5.5.03

A New Type of Superelastic and Shape Memory Materials—ThCr₂Si₂-Structured Novel Intermetallic Compounds at Small Length Scales [Seok-Woo Lee](#); University of Connecticut, United States.

9:15 AM CM5.5.04

Modeling the Coupled Mechanical-Magnetic and Shapememory Properties of ThCr₂Si₂-Type Crystals [Christopher Weinberger](#); Colorado State University, United States.

9:30 AM CM5.5.05

A Phase Field Study of the Role of Grain Size Distribution in Nanocrystalline Shape Memory Alloys [Jakub Mikula](#)^{1,2}; ¹A*Star, Singapore; ²NUS, Singapore.

9:45 AM CM5.5.06

Shape Memory Behavior of Pressure-Sensitive Photonic Crystal Polymers Determined by Material Composition and Structural Geometry [Curtis R. Taylor](#); University of Florida, United States.

10:00 AM BREAK

SESSION CM5.6: Strain-Coupling in Devices
Session Chairs: Chee Lip Gan and Hang Yu
Wednesday Morning, April 19, 2017
PCC North, 100 Level, Room 126 B

10:30 AM *CM5.6.01

Thin Film Mechanics and Electrical Properties of Amorphous Materials for Electronic Devices [Young-Chang Joo](#); Seoul National University, Korea (the Republic of).

11:00 AM CM5.6.02

Mechanical Reliability of Flexible Perovskite Solar Cell [Seung-Min Ahn](#); Ulsan National Institute of Science and Technology, Korea (the Republic of).

11:15 AM CM5.6.03

Coherent EUV Acoustic Nanometrology for Sub-50nm Thin Film Complete Mechanical Characterization [Nico Hernandez Charpak](#); University of Colorado Boulder, United States.

11:30 AM CM5.6.04

Ultra-High Fracture Strength of ALD Alumina Nanostructure for GaN LED Application [Sung-Gyu Kang](#)^{1,2}; ¹Seoul National University, Korea (the Republic of); ²Korea Institute of Science and Technology, Korea (the Republic of).

11:45 AM CM5.6.05

Stress-Directed Compositional Patterning of Compound Semiconductors to Create 2D Quantum Dot Arrays—Path to Mechanically Triggered Circuits [Brian D. Rummel](#); University of New Mexico, United States.

SESSION CM5.7: Strain-Optical Coupling
Session Chairs: Steven Boles and Austin Minnich
Wednesday Afternoon, April 19, 2017
PCC North, 100 Level, Room 126 B

1:30 PM *CM5.7.01

Strain-Optical Coupling in Mechanically Flexible Microphotonic Systems [Tian Gu](#); Massachusetts Institute of Technology, United States.

2:00 PM CM5.7.02

Molecular Engineering of Nano-Optomechanical Transducers [Jacqueline M. Cole](#)^{1,2,3}; ¹University of Cambridge, United Kingdom; ²STFC Rutherford Appleton Laboratory, United Kingdom; ³Argonne National Laboratory, United States.

2:15 PM CM5.7.03

Ultra-Fast Coherent X-Ray Diffraction of Deformation Modes in ZnO Nanocrystals [Mathew J. Cherukara](#); Argonne National Laboratory, United States.

2:30 PM BREAK

SESSION CM5.8: Strain-Induced Transformations in Vanadium Dioxide
Session Chairs: Dan Gianola and Heung Nam Han
Wednesday Afternoon, April 19, 2017
PCC North, 100 Level, Room 126 B

3:30 PM *CM5.8.01

Investigations of Coupled Mechanical and Electrical/Electrochemical Phenomena in VO₂ and Si Nanowires [Reiner Moenig](#)^{1,2}; ¹Karlsruhe Institute of Technology, Germany; ²Helmholtz Institute Ulm, Germany.

4:00 PM *CM5.8.02

“Smart” Applications with Metal-Insulator Phase Transition [Junqiao Wu](#); University of California, Berkeley, United States.

4:30 PM CM5.8.03

In Situ Nanomechanical Behavior VO₂ Microbeams across Phase Transition [Viswanath Balakrishnan](#); Indian Institute of Technology Mandi, India.

4:45 PM CM5.8.04

Rule of Composition Design for Crystal Growth in Modified Potassium Sodium Niobate Ceramics [Cheol-Woo Ahn](#); KIMS, Korea (the Republic of).

SESSION CM5.9: Strain-Coupling in Carbon Based Materials and Devices

Session Chairs: In-Suk Choi and Hang Yu

Thursday Morning, April 20, 2017

PCC North, 100 Level, Room 126 B

SESSION CM5.11: *In Situ* TEM of Mechanical Deformation

Session Chairs: In-Suk Choi and Seung Min Han

Thursday Afternoon, April 20, 2017

PCC North, 100 Level, Room 126 B

8:00 AM *CM5.9.01

Strengthening in Metal-Graphene Nanolayered Composites Synthesized via Roll-Based Graphene Transfer Methods [Seung Min J. Han](#); Korea Institute of Science and Technology, Korea (the Republic of).

8:30 AM CM5.9.02

Self-Ion Irradiation Effects on Mechanical and Thermal Properties of Nanocrystalline Zirconium Films [Aman Haque](#); The Pennsylvania State University, United States.

8:45 AM CM5.9.03

***In Situ* Mechanical Properties of 3D Materials Synthesized from Graphene and Carbon Nanotubes** [Sanjit Bhowmick](#); Hysitron Inc, United States.

9:00 AM CM5.9.04

Mechanical Testing and Characterization of CNTs-Based Thin-Film Conductive Tracks on Flexible Polymeric Substrates [Yuran Kang](#); Karlsruhe Institute of Technology, Germany.

9:15 AM CM5.9.05

Nanoscale Correlated Mechanical and Chemical Measurements on Patterned Porous Organo-Silicate Fins [Gheorghe Stan](#); National Institute of Standards and Technology, United States.

9:30 AM BREAK

SESSION CM5.10: Small-Scale Nanomechanical Testing

Session Chairs: Steven Boles and Ying Chen

Thursday Morning, April 20, 2017

PCC North, 100 Level, Room 126 B

10:00 AM *CM5.10.01

Reliability of Nanowire-Based Systems [Horacio D. Espinosa](#); Northwestern University, United States.

10:30 AM CM5.10.02

Experimentally Studying the Mechanical Properties of GaN Nanowires Based on Couple Stress Theory [Mohammad Reza Zamani Kouhpanji](#); University of New Mexico, United States.

10:45 AM CM5.10.03

Piezotronic Effect Modulated Heterojunction Electron Gas in AlGaN/AlN/GaN Heterostructure Microwire [Xingfu Wang](#); Georgia Institute of Technology, United States.

11:00 AM CM5.10.04

Exploring the Brittle-to-Ductile Transition of Silicon at the Microscale *In Situ* under Bending [Mohamed Elhebeary](#); University of Illinois at Urbana-Champaign, United States.

11:15 AM CM5.10.05

AM-FM—A Quantitative Nanomechanical Characterization Technique for Small-Scale and Low-Dimensional Materials [Marta Kocun](#); Asylum Research, United States.

11:30 AM CM5.10.06

Investigating the Mechanical and Piezoelectric Properties of Combinatorially Deposited (Al,Sc)N Thin Films Using Nano-Indentation Techniques [Dong Wu](#); Colorado School of Mines, United States.

11:45 AM CM5.10.07

Elasto-Plastic Deformation of Gold Thin Film Investigated by Hole-Nanoindentation [Na-Hyang Kim](#); Ulsan National Institute of Science and Technology, Korea (the Republic of).

1:30 PM *CM5.11.01

Tracking Shear-Migration Coupling of Grain Boundaries Using *In Situ* TEM [Marc Legros](#); CEMES CNRS, France.

2:00 PM CM5.11.02

***In Situ* TEM Study on the Dislocation Behavior in Micronanoscaled Single Crystal Metals** [Zhiwei Shan](#); Xi'an Jiaotong University, China.

2:15 PM CM5.11.03

Investigating the Deformation Behavior of Ultrafine-Grained Aluminum Films Using *In Situ* TEM Straining with Automated Crystal Orientation Mapping [Ehsan Izadi](#); Arizona State University, United States.

2:30 PM CM5.11.04

Crack Propagation in Monolayer MoS₂—An *In Situ* TEM Study [Aman Haque](#); The Pennsylvania State University, United States.

2:45 PM CM5.11.05

Small Scale Fatigue Fracture—Effect of Local Micro-Chemistry on Damage Evolution in Graded Bond Coats [Kaustubh Venkatraman](#); Indian Institute of Science, India.

3:00 PM BREAK

SESSION CM5.12: Plasticity

Session Chairs: Marc Legros and Reiner Moenig

Thursday Afternoon, April 20, 2017

PCC North, 100 Level, Room 126 B

3:15 PM *CM5.12.01

Electric Current-Induced Deformation Behavior in Metallic Materials [Heung Nam Han](#); Seoul National University, Korea (the Republic of).

3:45 PM CM5.12.02

Selective Oxidation-Induced Strengthening of Zr/Nb Nanoscale Multilayers [Javier Llorca](#); IMDEA Materials Institute & Technical University of Madrid, Spain.

4:00 PM CM5.12.03

Using Nanoindentation as a Mechanical Spectroscopy Tool—Investigating Incipient Plasticity Using *In Situ* 4-pt Bend Stage [Hakan Yavas](#); Johns Hopkins University, United States.

4:15 PM CM5.12.04

Mechanical Behavior of Nanotwinned Nanoporous Gold [Eun-Ji Gwak](#); Ulsan National Institute of Science and Technology, Korea (the Republic of).

4:30 PM *CM5.12.05

Helium Ion Microscope Fabrication Causing Changes in the Structure and Mechanical Behavior of Silicon Micropillars [Yuecun Wang](#); Xi'an Jiaotong University, China.