

SYMPOSIUM ES8

Caloric Materials for Energy-Efficient Applications
April 18 - April 20, 2017

Symposium Organizers

Christian Bahl, Technical University of Denmark
Jun Cui, Ames Laboratory, Iowa State University
Emmanuel Defay, Luxembourg Institute of Science and
Technology
Xavier Moya, University of Cambridge

Symposium Support
aixACCT Systems GmbH

Proceedings Statement

All authors are invited to submit articles based on their 2017 MRS Spring Meeting presentations to the journals in the MRS portfolio (www.mrs.org/publications-news). Papers submitted and accepted for publication in MRS Advances (www.mrs.org/mrs-advances) will be available as symposium collections. Visit the MRS/Cambridge University Press Publications Booth #100 in the Exhibit Hall to learn more, including MRS Advances print options available at special rates during the meeting week only.

* Invited Paper

TUTORIAL Caloric Materials and Devices

Monday Afternoon, April 17, 2017
1:30 PM – 5:00 PM
PCC North, 200 Level, Room 226 B

1:30 PM - 3:00 PM
Part I: **Mehmet Acet**

The first tutorial will start providing a general introduction to caloric effects and caloric materials. It will be shown that giant caloric effects occur in the vicinity of phase transitions. Results will be illustrated for giant magnetocaloric and mechanocaloric materials. Finally the relevance of dissipative effects and hysteresis will be considered.

3:00 PM - BREAK

3:30 PM - 5:00 PM
Part II: **Andrew Rowe**

The second tutorial reviews key principles governing the use of caloric materials in heat engines and heat pumps. A simplified analytic framework is presented and used to estimate performance of an active caloric regenerator cycle. Loss mechanisms are described and trade-offs between shape, size, operating frequency and matrix properties are quantified. Performance metrics relating material properties and operating conditions to cost are presented.

Instructors
Mehmet Acet, University Duisburg-Essen
Andrew Rowe, University of Victoria

SESSION ES8.1: Magnetocaloric Materials
Session Chairs: Mehmet Acet and Nini Pryds
Tuesday Morning, April 18, 2017
PCC North, 200 Level, Room 226 B

10:30 AM *ES8.1.01
CaloriCool™—The Caloric Materials Consortium [Vitalij K. Pecharsky](#);
Iowa State University, United States.

11:00 AM *ES8.1.02
Magneto-/Mechano-Caloric Effects in All-d-Metal Heusler Shape Memory Alloys [Enke Liu](#)^{1,2}; ¹Chinese Academy of Sciences, China; ²Max-Planck Institute for Chemical Physics of Solids, Germany.

11:30 AM *ES8.1.03
Characterization of Magnetocaloric Materials [Bruck Ekkes](#); TUD, Netherlands.

SESSION ES8.2: Electrocaloric Materials
Session Chairs: Neil Mathur and David Schwartz
Tuesday Afternoon, April 18, 2017
PCC North, 200 Level, Room 226 B

1:30 PM *ES8.2.01
Lead Scandium Tantalate as an Electrocaloric Testbed Material [Neil D. Mathur](#); University of Cambridge, United Kingdom.

2:00 PM *ES8.2.02
Nanostructured Ferroelectric Polymer Nanocomposites Exhibiting Giant Electrocaloric Effect [Qing Wang](#); Pennsylvania State University, United States.

2:30 PM *ES8.2.03
Recent Progress on Electrocaloric Multilayer Ceramic Capacitor Development [Sakyo Hirose](#); Murata Manufacturing Co., Ltd., Japan.

3:00 PM BREAK

3:30 PM *ES8.2.04
Relaxor-Ferroelectric Ceramics for Efficient Electrocaloric Cooling [Hana Ursic](#); Jozef Stefan Institute, Slovenia.

4:00 PM ES8.2.05
Electrocaloric Effect in Lead-Free Ferroelectric Ceramics Measured Directly [Mehmet Sanlialp](#); University Duisburg-Essen, Germany.

4:15 PM ES8.2.06
Electrocaloric Effect in PZ-Based Antiferroelectrics [Zdravko Kutnjak](#); Jozef Stefan Institute, Slovenia.

4:30 PM ES8.2.07
Screening and Reliability of Multi-Layer Capacitors for Electrocaloric Cooling [Romain Faye](#); Luxembourg Institute of Science and Technology, Luxembourg.

4:45 PM ES8.2.08
Colossal Electrocaloric Effect of Polymer Composites with Nanostructured Ceramic Fillers [Guangzu Zhang](#)^{2,1}; ¹The Pennsylvania State University, United States; ²Huazhong University of Science and Technology, China.

SESSION ES8.3: Magnetocalorics, Modeling and Materials
Session Chairs: Vitalij Pecharsky and Julie Staunton
Wednesday Morning, April 19, 2017
PCC North, 200 Level, Room 226 B

8:30 AM *ES8.3.01
Caloric Effects from Fluctuating Local Magnetic Moments and Itinerant Electrons Described by Ab Initio Theory [Julie B. Staunton](#); University of Warwick, United Kingdom.

9:00 AM ES8.3.02
Assessing Performance of Caloric Material Refrigerants through Hysteretic Thermodynamic Modeling [Patrick Shamberger](#); Texas A&M University, United States.

9:15 AM ES8.3.03
Localized Modeling of First Order Magnetocaloric Materials with a Distribution in Curie Temperature [Kaspar K. Nielsen](#); Technical University of Denmark, Denmark.

9:30 AM ES8.3.04

Rare Earth Based Magnetocaloric Refrigerant Materials for Gas Liquefaction [Brandt Jensen](#); Ames Laboratory, US-DOE, United States.

9:45 AM BREAK

10:15 AM ES8.3.05

Affordable, High Performance Magnetocaloric Nanomaterials and Systems [Raju V. Ramanujan](#); Nanyang Technological University, Singapore.

10:30 AM *ES8.3.06

Recent Developments in Gd Alloy Microwires for Energy-Efficient Magnetic Refrigeration [Manh-Huong Phan](#); University of South Florida, United States.

SESSION ES8.4: Electrocalorics, Modeling and Materials
Session Chairs: Emmanuel Defay and Inna Ponomareva
Wednesday Morning, April 19, 2017
PCC North, 200 Level, Room 226 B

11:00 AM *ES8.4.01

First Principles-Based Investigation of the Electro-Caloric Effect [Claude Ederer](#); ETH Zurich, Switzerland.

11:30 AM ES8.4.02

Measurement Artefacts in Electrocalorics [Bhasi Nair](#); University of Cambridge, United Kingdom.

11:45 AM ES8.4.03

Phase Transition Behavior and Electrocaloric Effect in Bi-Based Perovskites and Barium Titanate Solid Solutions [Chae Il Cheon](#); Hoseo University, Korea (the Republic of).

SESSION ES8.5: Caloric Devices
Session Chairs: Jun Cui and Andrew Rowe
Wednesday Afternoon, April 19, 2017
PCC North, 200 Level, Room 226 B

1:30 PM ES8.5.01

Electrocaloric Cooling Systems—Theory to Demonstration [David E. Schwartz](#); PARC, United States.

1:45 PM ES8.5.02

Electrocaloric Refrigeration Using Commercial Multi-Layer Capacitors and Fluid-Assisted Thermal Regeneration [Emmanuel Defay](#); Luxembourg Institute of Science and Technology, Luxembourg.

2:00 PM ES8.5.03

Improved Performance from Heat Transfer Gas By-Pass Flow during the Cold-to-Hot Flow Step of an Active Magnetic Regenerative Liquefier [Jamie Holladay](#); Pacific Northwest National Lab, United States.

2:15 PM ES8.5.04

Optimising the Design of a Magnetocaloric Heat Pump [Christian Bahl](#); Technical University of Denmark, Denmark.

2:30 PM BREAK

3:30 PM *ES8.5.05

Highly Efficient Caloric Devices [Nini Pryds](#); TU Denmark, Denmark.

4:00 PM *ES8.5.06

Small Scale Elastocaloric Cooling by SMA Films [Manfred Kohl](#); Karlsruhe Institute of Technology, Germany.

4:30 PM *ES8.5.07

Compression-Based Elastocaloric Materials and Cooling Devices [Ichiro Takeuchi](#); University of Maryland, United States.

SESSION ES8.6: Mechanocalorics, Modeling and Materials

Session Chairs: Xavier Moya and Ichiro Takeuchi

Thursday Morning, April 20, 2017

PCC North, 200 Level, Room 226 B

9:00 AM *ES8.6.01

Caloric Effects from Direct First-Principles Simulations [Inna Ponomareva](#); University of South Florida, United States.

9:30 AM *ES8.6.02

Elastocaloric Effect in Natural Rubber and P(VDF-TrFE-CFTE) Terpolymer [Gael Sebald](#)^{1,2}; ¹ELYTMAX - Université de Lyon - CNRS - Tohoku University, Japan; ²Université de Lyon, INSA-Lyon, France.

10:00 AM BREAK

10:30 AM ES8.6.03

Giant Barocaloric Effects in Ferroelectrics [Xavier Moya](#); University of Cambridge, United Kingdom.

10:45 AM ES8.6.04

Effect of Pressure on Spin Crossover Compounds for Barocaloric Applications [Steven Vallone](#)^{1,2}; ¹Brooklyn College of The City University of New York, United States; ²The Graduate Center, CUNY, United States.

11:00 AM ES8.6.05

Large Caloric Effects in Soft Materials [Zdravko Kutnjak](#); Jozef Stefan Institute, Slovenia.

11:15 AM ES8.6.06

Infra-Red Imaging of Elastocaloric Polymers [Alex Avramenko](#); University of Cambridge, United Kingdom.

SESSION ES8.7: Magnetocaloric Materials
Session Chairs: Christian Bahl and Bruck Ekkes
Thursday Afternoon, April 20, 2017
PCC North, 200 Level, Room 226 B

1:30 PM *ES8.7.01

Entropic Features of the Electronic Phase Owing to Multiple Degrees of Freedom of Electron [Asaya Fujita](#); AIST Chubu, Japan.

2:00 PM *ES8.7.02

Large Magnetization and Reversible Magnetocaloric Effect at the Second-Order Magnetic Phase Transition in Heusler Materials [Luana Caron](#); Max Planck Institute for Chemical Physics of Solids, Germany.

2:30 PM *ES8.7.03

A Search for Advanced Magnetic Refrigerant Materials in the Heusler Alloy System [Francis Johnson](#); GE Global Research, United States.

3:00 PM BREAK

3:30 PM ES8.7.04

Controlling the Magnetic Properties of $\text{La}(\text{Fe},\text{Mn},\text{Si})_{13}$ and Its Hydrides with Pressure [Henrique Neves Bez](#); Ames Laboratory, United States.

3:45 PM ES8.7.05

Phase Transition Growth Dynamics in $\text{La}(\text{Fe},\text{Mn},\text{Si})_{13}$ Magnetocaloric Compounds [Edmund Lovell](#); Imperial College London, United Kingdom.

4:00 PM ES8.7.06

Structural and Magnetocaloric Properties of Ball Milled $\text{LaFe}_{13-x}\text{Si}_x(\text{H},\text{C})_y$ [Lotfi Bessais](#); CNRS, France.

4:15 PM ES8.7.07

Inverse Magnetocaloric Effect in Metamagnetic Ni-Mn-In-Based Alloys in High Magnetic Fields [Sudip Pandey](#); Southern Illinois University, United States.

4:30 PM ES8.7.08

Magnetocaloric Improvements in Doped Heusler Alloys [Michael V. McLeod](#); New Mexico Tech, United States.

4:45 PM ES8.7.09

Direct Measurement of Magnetocaloric Effect in $\text{Ni}_{2+x}\text{Mn}_{1-x}\text{Ga}$ ($0.18 \leq x \leq 0.27$) with Coupled Magnetostructural Phase Transition Vladimir Khovaylo; National University of Science and Technology, Russian Federation.

SESSION ES8.8: Poster Session
Session Chair: Luana Caron
Thursday Afternoon, April 20, 2017
8:00 PM - 10:00 PM
Sheraton, Third Level, Phoenix Ballroom

ES8.8.01

Giant Magnetocaloric Effect Induced by Reemergence of Magnetostructural Coupling in Si-Doped $\text{Mn}_{0.95}\text{CoGe}$ Compounds Hu Zhang; School of Materials Science and Engineering, University of Science and Technology of Beijing, China.

ES8.8.02

Magnetocaloric Properties of HoNi Melt-Spun Ribbons Cesar Fidel Sanchez-Valdes; División Multidisciplinaria, Ciudad Universitaria, Universidad Autónoma de Ciudad Juárez (UACJ), Mexico.

ES8.8.03

Effect of Annealing on the Magnetic, Thermal and Magnetocaloric Properties of B Doped Ni-Mn-In Ribbons Sudip Pandey; Southern Illinois University, United States.

ES8.8.04

Multi-Regime Non-Linear Pyroelectric Energy Harvesting in Thin Films Andrew Smith; U.S. Naval Academy, United States.

ES8.8.05

Bending-Mode Elastocaloric Cooling Darin J. Sharar; U.S. Army Research Laboratory, United States.

ES8.8.06

Magnetocaloric Effect in Severe Plastically Deformed Ferromagnetic 4-f Elements—Gd, Tb, Dy, Ho and Er Sergey V. Taskaev^{1,2}; ¹Chelyabinsk State University, Russian Federation; ²National University of Science and Technology (MISIS), Russian Federation.