

## ***Program***

# **Electric Field Enhanced Processing of Advanced Materials II: Complexities and Opportunities**

**March 10-15, 2019  
Hotel Dos Templarios  
Tomar, Portugal**

### **Conference Chairs**

**Rishi Raj**

University of Colorado, USA

**Olivier Guillon**

Forschungszentrum Jülich, Germany

**Hidehiro Yoshida**

The University of Tokyo, Japan



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**Previous conferences in this series:**

***Electric Field Assisted Sintering and Related Phenomena Far From Equilibrium***

**March 6-11, 2016**

**Tomar, Portugal**

*Conference Chairs:*

Rishi Raj, University of Colorado at Boulder, USA

Thomas Tsakalakos, Rutgers University, USA

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## **Sunday, March 10, 2019**

16:30 – 18:30	Conference Check-in
18:30 – 19:30	Welcome Reception with music
19:30 – 21:00	Dinner

### ***Locations and Notes***

- *Technical sessions will be in the Infante Room. Poster sessions will be in the Convento Room.*
- *Audio, still photo and video recording by any device (e.g., cameras, cell phones, laptops, PDAs, watches) are strictly prohibited during the technical sessions, unless the author and ECI have granted prior permission.*
- *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.*
- *Meals: Breakfast is in the Breakfast Room; Lunches and dinners are in the Restaurant.*
- *Coffee breaks are held in the Lobby (unless otherwise announced).*
- *Please do not smoke at any conference functions.*
- *Turn your mobile telephones to vibrate or off during technical sessions.*
- *Please write your name on your program so that it can be returned to you if lost or misplaced.*
- *After the conference, ECI will send an updated participant list to all participants. Please check your listing now and if it needs updating, you may correct it at any time by logging into your ECI account.*
- *Emergency Contact Information: Because of privacy concerns, ECI does not collect or maintain emergency contact information for conference participants. If you would like to have this information available in case of emergency, please place your emergency contact information on the reverse side of your name badge.*

**Monday, March 11, 2019**

07:30 – 08:30 Breakfast

08:30 – 10:00 ***Topic 1: Manufacturing (SPS, Large Samples, Sinter Forging, Additives)***

**Field assisted sintering of larger scaled ceramic parts using adapted tool design and hybrid heating**

Martin Bram, Forschungszentrum Jülich GmbH, Germany

**Elaboration of complex shapes by spark plasma sintering**

Antoine van der Laan, CIRIMAT, Université De Toulouse, CNRS, France

**Flash sintering of injection molded zirconia under AC electric field for enhancement of optical properties**

Andre L. G. Prette, Lucideon, United Kingdom

**Electrical field assisted sintering of yttrium-doped ceria investigated by sinter-forging**

Olivier Guillon, Forschungszentrum Jülich GmbH, Germany

10:00 – 10:30 Coffee Break

10:30 – 12:00 **Advantages of the method of high-voltage consolidation of powder materials**

Evgeny Grigoryev, ISMAN, Russia

**Flash sintering of beta-alumina solid electrolytes for sodium battery applications**

Gareth Jones, The University of Warwick, United Kingdom

***Topic 2: In-Situ and Ex-Situ Characterization and Methods (X-ray, TEM, Optical, Mechanical)***

**Electrochemical, optical and thermal effects during flash sintering of 8YSZ**

Mattia Biesuz, Queen Mary University of London, United Kingdom

**Study of the phase transformation induced by flash sintering in  $Mn_2O_3$  and the investigation of the role of defects in flash sintering using in-situ Raman spectroscopy**

Shannon Murray, University of Illinois at Urbana Champaign, USA

12:00 – 12:45

***Posters Highlights and Visits***

**NP-1 Field Assisted Material Engineering (FAME)**

Mattia Biesuz, Queen Mary University of London, United Kingdom

**NP-2 Hybrid sintering – The beneficial combination of sintering principles**

Juergen Hennicke, FCT Systeme GmbH, Germany



**Monday, March 11, 2019 (continued)**

- NP-3      Exploitation of industrial application of FLASH to sinter ceramics**  
Ricardo Serrazina, University of Aveiro, Portugal
- NP-4      "Fields Matter" initiative in Germany**  
Olivier Guillon, Forschungszentrum Jülich GmbH, Germany
- NP-5      Field assisted processing of 3D printed ceramics**  
Bala Vaidhyanathan, Loughborough University, United Kingdom

13:00 – 14:30      Lunch

14:30 – 15:45      ***Topic 2 (continued): In situ and ex situ Characterization and Methods (X-ray, TEM, Optical, Mechanical)***

**Increase in hardness for flash sintered ceramics**  
David Kok, University of California, Irvine, USA

**In-situ x-ray characterization of phase evolution during solid-state reactions of multicomponent systems**  
Sanjit Ghose, NSLS II, Brookhaven National Laboratory, USA

**Solute-drag vs solute-acceleration during microstructural evolution of alumina**  
Wayne D. Kaplan, Technion - Israel Institute of Technology, Israel

15:45 – 16:15      Coffee Break

16:15 – 17:15      **Dielectric behavior of FLASH sintered KNN**  
Paula M. Vilarinho, University of Aveiro, Portugal

***Topic 3: Computational and Analytical (First Principles, Molecular Dynamics, Models, Large Data)***

**Formation of defect-enriched phases far from equilibrium as a flash sintering mechanism**  
Malte Jongmanns, University of Duisburg-Essen, Germany

17:15 – 18:00      ***Posters Highlights and Visits***

- NP-6      Influence of 3YSZ sample height at the onset temperature of flash sintering**  
João Vitor Campos, University of São Paulo, Brazil
- NP-7      Photoluminescence in SPS-processed transparent Ce:YAG ceramics**  
Avital Wagner, Ben-Gurion University of the Negev, Israel

**Monday, March 11, 2019 (continued)**

- NP-8**    **In situ measurements of partial discharge patterns on porous YSZ pellets pressed between planar platinum electrodes used for flash sintering**  
Jean-Francois Fagnard, University of Liege, Belgium
- NP-9**    **A novel system for quenching during flash sintering**  
Mattan Becker, Technion, Israel
- NP-10**   **In situ electron microscopy studies of electric field assisted sintering of oxide ceramics**  
Danny Schwarzbach, Georg-August-University Goettingen, Germany
- NP-11**   **Tensile strength of materials obtained by electric pulse consolidation of powders**  
Evgeny Grigoryev, ISMAN, Russia

- 18:00 – 19:00    General Discussion (all hands present)
- 19:30 – 21:00    Dinner
- 21:00 – 23:00    Poster Viewing / Social Period

**Tuesday, March 12, 2019**

07:30 – 08:30 Breakfast

08:30 – 10:00 ***Topic 3 (continued): Computational and Analytical (First Principles, Molecular Dynamics, Models, Large Data)***

**Deep learning of CVD growth and phase-transition pathways in layered materials**

Rajiv Kalia, University of Southern California, USA

**Modeling of Joule heating in KNN FLASH sintering**

Ricardo Serrazina, University of Aveiro, Portugal

**Thermal runaway, dynamic stability and process control in flash sintering**

João Pereira da Silva, Forschungszentrum Jülich, Germany

10:00 – 10:30 Coffee Break

10:30 – 12:00 **Kinetics of liquid-assisted densification during flash sintering of ceramic nanoparticles**

Rachman Chaim, Technion-Israel, Israel

**Impedance characterization of calcia-stabilized zirconia as a function of applied field**

Julia Ramírez González, The University of Sheffield, United Kingdom

**High temperature tensile behavior of zirconia ceramics under DC current**

Koji Morita, National Institute for Materials Science (NIMS), Japan

**Densification and grain growth kinetics of 3mol% Y<sub>2</sub>O<sub>3</sub> stabilized zirconia during flash sintering**

Ke Ren, Northwestern Polytechnique University, China

12:00 – 12:45

***Posters Highlights and Visits***

**NP-12 Microstructure evolution during high-pressure spark plasma sintering (HPSPS) of transparent alumina**

Barak Ratzker, Ben-Gurion University of the Negev, Israel

**NP-13 Impact of an external electric field on grain growth in oxides: Comparison of flash sintered samples to field assisted grain growth**

Jan Preusker, KIT, Germany

**NP-14 Pattern formation during current sintering (Simulation)**

Lukas Engelke, University of Duisburg-Essen, Germany

**NP-15 Microstructural evolution of 3YSZ flash sintered with current ramp control**

Isabela R. Lavagnini, University of São Paulo, Brazil

**Tuesday, March 12, 2019 (continued)**

**NP-16 Influence of the conformation method on flash sintering of ZnO ceramics**  
Ana Storion, University of São Paulo, Brazil

**NP-17 DC electric field assisted 3YSZ ceramic superplastic deformation**  
Dianguang Liu, Southwest Jiaotong University, China

13:00 – 14:30 Lunch

14:30 – 15:45 ***Topic 4: Ionic Materials and Glasses (YSZ, Urania, Ceria, Liquid Phase)***

**Deformation mechanisms of flash sintered yttria-stabilized zirconia via in situ micromechanical testing**  
Jaehun Cho, Purdue University, USA

**Low temperature and high strain rate superplastic flow in structural oxide ceramics induced by flash event**  
Hidehiro Yoshida, The University of Tokyo, Japan

**The onset of flash sintering 8YSZ**  
Jinling Liu, Southwest Jiaotong University, China

15:45 – 16:15 Coffee Break

16:15 – 17:15 **Comparison of the electrical and structural properties of flash sintered yttria-stabilized zirconia**  
Carolyn Grimley, North Carolina State University, USA

**Study of flash phenomena on single crystals of cubic 8 mol% yttria stabilized zirconia**  
Devinder Yadav, Indian Institute of Technology Patna, India

17:15 – 18:00 **Poster Visits**

18:00 – 19:00 General Discussion (all hands present)

19:30 – 21:00 Dinner

21:00 – 23:00 Poster Viewing and Social Period

**Wednesday, March 13, 2019**

07:30 – 08:30 Breakfast

08:30 – 10:00 ***Topic 4 (continued): Ionic Materials and Glasses (YSZ, Urania, Ceria, Liquid Phase)***

**Electric field induced softening of glass: What can it tell about the mechanism of flash sintering?**

Himanshu Jain, Lehigh University, USA

***Topic 5: Futuristic Discussion Topics (Heating Rate, Ionic/Electronic, Phonons/Electrons, Interfaces and Electrode Effects)***

**Reaction flash sintering for producing high quality functional ceramics within seconds**

Luis A. Perez-Maqueda, Instituto de Ciencia de Materiales de Sevilla (CSIC-US), Spain

**Charged grain boundaries and the microstructural evolution of ionic ceramics**

Edwin Garcia, Purdue University, USA

10:00 – 10:30 Coffee Break

10:30 – 12:00 **Enhanced ionic conductivity of 8 mol% yttria stabilized zirconia by flash sintering**

Xavier Vendrell, Polytechnic University of Catalonia, Spain

**Local structure and kinetics of defect accumulation in titania flash events**

Daniel Shoemaker, University of Illinois, USA

**Mixed ionic electronic conductivity and flash sintering**

Ilan Riess, Technion, Israel

**Metastable nanomaterials and nanocomposites obtained by high-pressure torsion powder consolidation**

Stefan Wurster, Erich Schmid Institute of Materials Science, Austria

12:00 – 12:45

***Posters Highlights and Visits***

**NP-18 Field-induced mass transport phenomena in flash sintered high temperature ceramics explored by in situ SEM and TEM**  
Jaehun Cho, Purdue University, USA

**NP-19 Flash sintering of ceramic films: The influence of surface to volume ratio**  
Viviana Avila, University of Colorado Boulder, USA

**NP-20 Transition to partial electronic conductivity at the onset of flash measured by in-situ impedance spectroscopy**  
Seohyeon Jo, University of Colorado Boulder, USA

**Wednesday, March 13, 2019 (continued)**

**NP-21 In-situ measurements of the elastic modulus of zirconia polycrystals held in a state of flash induced by an electric field**  
Rishi Raj, University of Colorado Boulder, USA

**NP-21A Current rate flash of carbon fibers**  
Rishi Raj, University of Colorado Boulder, USA

**NP-22 Unusual atom displacements in TiO<sub>2</sub> during flash sintering**  
Bola Yoon, University of Colorado Boulder, USA

**NP-23 Powders of four elemental oxides transformed and sintered by reactive flash**  
Viviana Avila, University of Colorado Boulder, USA

13:00 – 14:30

Lunch

14:30 – 19:00

Excursion - Guided tour of the Convento de Cristo (a UNESCO World Heritage Site), Tomar's most famous landmark. The Convento is on a hill overlooking town, within easy walking distance of the hotel. The Convento combines architectural styles from the 12<sup>th</sup> through 17<sup>th</sup> centuries. An ornate octagonal canopy protects the high altar of the Templo dos Templares, modeled after the Holy Sepulchre in Jerusalem. The grounds of the convent contain eight cloisters embracing a variety of styles. After the Convento de Cristo, the tour will continue in the historic area of Tomar.

19:30 – 21:00

Dinner

21:00 – 23:00

Poster Viewing and Social Period

**Thursday, March 14, 2019**

07:00 – 08:30 Breakfast

08:30 – 10:00 ***Topic 5 (continued): Futuristic Discussion Topics (Heating Rate, Ionic/Electronic, Phonons/Electrons, Interfaces and Electrode Effects)***

**Some observations on the response of oxides to an applied field**

Anthony West, University of Sheffield, United Kingdom

***Topic 6: SPS and Microwave (Common Themes, Linkage to Flash)***

**Ultra-rapid microwave sintering of ceramics and powder metals**

Kirill I. Rybakov, Russian Academy of Sciences, Russia

**Effective colloidal processing for densification before SPS**

Tohru S. Suzuki, National Institute for Materials Science, Japan

10:00 – 10:30 Coffee Break

10:30 – 12:00 **The role of defects in microwave-assisted synthesis of cubic ZrO<sub>2</sub>**

Nathan J. Nakamura, Carnegie Mellon University, USA

**Electric field assisted densification of 10 mol% gadolinium doped ceria (GDC 10)**

Tarini Prasad Mishra, Forschungszentrum Jülich GmbH, Germany

**Some strategies to (co)-sinter refractory functional oxides at low temperature by spark plasma sintering**

Catherine Elissalde, ICMCB/CNRS, France

**Cool-SPS: Pulling down the temperature, pushing up the reactivity**

Michaël Josse, Université de Bordeaux, ICMCB, France

12:00 – 12:45

***Posters Highlights and Visits***

**NP-24 Lattice softening**

Rishi Raj, University of Colorado Boulder, USA

**NP-25 A short review of FS mechanisms**

Yoed Tsur, Technion, Israel Institute of Technology, Israel

**NP-26  $\beta$ -SiAlON-based ceramic composites by combustion synthesis and spark plasma sintering**

Evgeny Grigoryev, ISMAN, Russia

**NP-27 Evidence for microstructure-dependent hysteresis in SCO molecular ceramics prepared by cool-SPS**

Liza El Khoury, ICMCB/Bordeaux University, France

**Thursday, March 14, 2019 (continued)**

**NP-28 W-Cr solid solution: Comparison of alloying in SPS and by ball milling**

Monika Vilémová, Institute of Plasma Physics AS CR, v.v.i.,  
Czech Republic

**NP-29 Flash joining of graphite with polymer derived ceramic interlayer**

Mattia Biesuz, Queen Mary University of London, United  
Kingdom

13:00 – 14:30

Lunch

14:30 – 15:45

***Topic 6 (continued): SPS and Microwave (Common Themes, Linkage to Flash)***

**Grain growth behavior during spark plasma sintering of ceramics**

Byung-Nam Kim, National Institute for Materials Science, Japan

***Topic 7: Metallic, Conductive and Non-Oxides (Metals, Semiconductors, Carbon)***

**Densification of NdFeB magnets by electro-discharge sintering - Microstructure, mechanical and magnetic properties**

Lennart Leich, Ruhr-Universität Bochum, Lehrstuhl Werkstofftechnik, Germany

**Electrical-field assisted flash joining of ceramic oxide-ceramic oxide and ceramic oxide-metal**

Yiguang Wang, Beijing Institute of Technology, China

15:45 – 16:15

Coffee Break

16:15 – 17:15

**Flash sintering of armor materials: Challenges and opportunities**

Andrew Rosenberger, Army Research Laboratory, USA

**Effect of the addition of doped-cobalt on the properties of recycled tungsten carbide powder sintered by SPS**

Alexandre Mégret, University of Mons, Belgium

17:15 – 18:00

***Poster Highlights and Visits***

**NP-30 The effect of high current densities on iron-carbon alloy thin films**

Thomas Brede, Institute of Materials Physics, Germany

**NP-31 Effect of electric current annealing in phase transition of Mn-Al alloy**

Fernando Maccari, Technical University of Darmstadt, Germany

**NP-32 Insights into reactive flash sintering of MgO-Al<sub>2</sub>O<sub>3</sub>-(8YSZ) by in-situ synchrotron X-ray diffraction**

Bola Yoon, University of Colorado Boulder, USA



**Thursday, March 14, 2019 (continued)**

- NP-33 Flash sintering of zirconia/alumina powders**  
Rebecca O'Toole, University of Colorado Boulder, USA
- NP-34 The influence of carbon on the microstructure of sintered alumina**  
Rachel Marder, Technion- Israel Institute of Technology, Israel
- NP-35 Densification of classic and fragile ferroelectrics by Cool-SPS**  
Flora Molinari, ICMCB-CNRS, Université de Bordeaux, France
- NP-36 Eutectic microstructures by flash sintering**  
Martha Mecartney, University of California, Irvine, USA

- 18:00 – 19:00 General Discussion (all hands present)
- 19:30 – 21:30 Gala Dinner
- 21:30 – 23:00 Poster Viewing and Social Period

**Friday, March 15, 2019**

- 07:30 – 08:30 Breakfast
- 08:30 – 09:00 Discussion of Future Meetings and Community Building Activities
- 09:00 – 10:30 **Various talks**
- Rishi Raj, Announcement of Next Meeting, Steering Committee and a Student Chapter**
- Anomalous twinning in AZ 31 magnesium alloy during electrically assisted forming**  
Franz Körkemeyer, Institut für Werkstoffkunde, Leibniz-Universität Hannover, Germany
- Evidence of localized, incipient melting during field-assisted sintering of oxide dispersion strengthened, nanocrystalline metals**  
(Substitute) Sean J. Fudger, US Army Research Laboratory, USA
- Atom displacement during in-situ Synchrotron Measurements in TiO<sub>2</sub> in Stage III of flash**  
Bola Yoon, Colorado, USA
- Influence of Surface to Volume Ratio on the Onset of Power Density and Full Densification of YSZ**  
Viviana Avila, Colorado, USA
- 10:30 – 11:00 Coffee Break
- 11:00 – 12:30 **Triggering the catalytic activity of SrTiO<sub>3</sub>-based ceramics by flash sintering**  
Simone Mascotto, University of Hamburg, Germany
- Atmosphere assisted FLASH sintering of KNN**  
Ana Senos, University of Aveiro, Portugal
- Studies of Current Localization during Flash**  
Seohyeon Jo, Colorado USA
- Flash of Zirconia Particle Coated with Nanoscale Alumina**  
Becky O'Toole, Colorado, USA
- Flash Crystallization of Pitch Carbon Fibers**  
Rubens Ingracia (Rishi Raj), Colorado, USA
- 12:30 Lunch and departures

## *Posters*

# **Electric Field Enhanced Processing of Advanced Materials II: Complexities and Opportunities**



**Engineering Conferences International**

## Poster Presentations

- NP-1 Field Assisted Material Engineering (FAME)**  
Mattia Biesuz, Queen Mary University of London, United Kingdom
- NP-2 Hybrid sintering – The beneficial combination of sintering principles**  
Juergen Hennicke, FCT Systeme GmbH, Germany
- NP-3 Exploitation of industrial application of FLASH to sinter ceramics**  
Ricardo Serrazina, University of Aveiro, Portugal
- NP-4 "Fields Matter" initiative in Germany**  
Olivier Guillon, Forschungszentrum Jülich GmbH, Germany
- NP-5 Field assisted processing of 3D printed ceramics**  
Bala Vaidhyanathan, Loughborough University, United Kingdom
- NP-6 Influence of 3YSZ sample height at the onset temperature of flash sintering**  
João Vitor Campos, University of São Paulo, Brazil
- NP-7 Photoluminescence in SPS-processed transparent Ce:YAG ceramics**  
Avital Wagner, Ben-Gurion University of the Negev, Israel
- NP-8 In situ measurements of partial discharge patterns on porous YSZ pellets pressed between planar platinum electrodes used for flash sintering**  
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- NP-12 Microstructure evolution during high-pressure spark plasma sintering (HPSPS) of transparent alumina**  
Barak Ratzker, Ben-Gurion University of the Negev, Israel
- NP-13 Impact of an external electric field on grain growth in oxides: Comparison of flash sintered samples to field assisted grain growth**  
Jan Preusker, KIT, Germany
- NP-14 Pattern formation during current sintering (Simulation)**  
Lukas Engelke, University of Duisburg-Essen, Germany
- NP-15 Microstructural evolution of 3YSZ flash sintered with current ramp control**  
Isabela R. Lavagnini, University of São Paulo, Brazil
- NP-16 Influence of the conformation method on flash sintering of ZnO ceramics**  
Ana Storion, University of São Paulo, Brazil

- NP-17**    **Dc Electric Field Assisted 3-axis Ceramic Superplastic Deformation**  
Dianguang Liu, Southwest Jiaotong University, China
- NP-18**    **Field-induced mass transport phenomena in flash sintered high temperature ceramics explored by in situ SEM and TEM**  
Jaehun Cho, Purdue University, USA
- NP-19**    **Flash sintering of ceramic films: The influence of surface to volume ratio**  
Viviana Avila, University of Colorado Boulder, USA
- NP-20**    **Transition to partial electronic conductivity at the onset of Flash measured by in-situ impedance spectroscopy**  
Seohyeon Jo, University of Colorado Boulder, USA
- NP-21**    **In-situ measurements of the elastic modulus of Zirconia polycrystals held in a state of flash induced by an electric field**  
Rishi Raj, University of Colorado Boulder, USA
- NP-21A**    **Current rate flash of carbon fibers**  
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- NP-22**    **Unusual atom displacements in TiO<sub>2</sub> during flash sintering**  
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- NP-23**    **Powders of four elemental oxides transformed and sintered by reactive flash**  
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- NP-24**    **Lattice softening**  
Rishi Raj, University of Colorado Boulder, USA
- NP-25**    **A short review of FS mechanisms**  
Yoed Tsur, Technion, Israel Institute of Technology, Israel
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