Final Program

Kathy Chan

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Program

Electric Field Assisted Sintering and Related Phenomena Far from Equilibrium

March 6 – 11, 2016

Hotel dos Templários
Tomar, Portugal

Conference Chair
Rishi Raj
University of Colorado at Boulder, USA

Conference Co-Chair
Thomas Tsakalakos
Rutgers University, USA
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Tomar, Portugal
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Army Research Office

Office of Naval Research Global Office
Sunday, March 6, 2016

16:00 – 18:00  Conference Check-in
18:00 – 19:30  Welcome Reception (Lobby Bar)
19:30 – 22:00  Dinner followed by Reception

NOTES

• Audiotaping, videotaping and photography of presentations are strictly prohibited.
• Speakers – Please leave at least 5 minutes for questions and discussion.
• Please do not smoke at any conference functions.
• Turn your cellular telephones to vibrate or off during technical sessions.
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• Be sure to check the participant list in this booklet to confirm that your listing is correct. If there are changes or updates, please login to the ECI website and update your listing so that the list that ECI will send to all participants after the conference will be correct.
Monday, March 7, 2016

07:30 – 08:30 Breakfast

08:30 – 08:35 Welcome – Conference Chairs

Introductory Remarks:
ECI Liaison – Lawrence Kabacoff

Session 1: Flash, Microwave, SPS and Grain Growth – I
Session Chair: Rishi Raj, University of Colorado at Boulder, USA

08:35 – 09:05 Electric field–induced electronic conduction in bulk oxide ceramics
Anthony R. West, University of Sheffield, United Kingdom

09:05 – 09:35 Flash microwave sintering of oxide ceramics
Kirill I. Rybakov, Institute of Applied Physics, Russian Academy of Sciences;
Lobachevsky State University of Nizhny Novgorod, Russia

09:35 – 10:05 Flash sintering of covalent non–oxide ceramics at low temperatures with low DC electric fields: An in situ EDXRD study by synchrotron probe
Thomas Tsakalakos, Rutgers University, USA

10:05 – 10:25 Coffee Break

10:25 – 10:55 Field–assisted and flash sintering of nanocrystalline yttria: Densification and microstructural evolution
Hidehiro Yoshida, National Institute for Materials Science, Japan

10:55 – 11:25 Electroluminescence and Heating Rates during Flash
Rishi Raj, University of Colorado Boulder, USA

11:25 – 11:55 Highly transparent spinel windows by microwave sintering
Jasbinder Sanghera, Naval Research Laboratory, USA

11:55 – 12:25 Coffee Break

12:25 – 12:55 The influence of fields and dopants on grain boundary mobility
Wayne D. Kaplan, Technion – Israel Institute of Technology, Israel

12:55 – 13:25 Spark plasma sintering of a functionally graded material consisting of a high–alloyed CrMnNi–steel and varying Mg–PSZ content
Sabine Decker, Technical University Bergakademie Freiberg, Germany

13:25 – 14:30 Lunch
Monday, March 7, 2016 (continued)

**Session 2: Flash, Microwave, SPS and Grain Growth – II**
Session Chair: Thomas Tsakalakos, Rutgers University, USA

14:30 – 15:00  
**Electrical conduction mechanism at high voltages and dielectric breakdown strength in bulk ceramic insulators**  
Gerold A. Schneider, Hamburg University of Technology, Germany

15:00 – 15:30  
**Oxygen vacancy formation due to DC electric fields during flash sintering in BaTiO₃**  
Takahisa Yamamoto, Nagoya University, Japan

15:30 – 16:00  
**Effect of electric field/current on liquid phase sintering**  
Jesus Gonzalez-Julian, Forschungszentrum Jülich GmbH, Germany

16:00 – 16:30  
Coffee Break

16:30 – 17:00  
**Influence of an electric field on grain growth and sintering in strontium titanate**  
Fabian Lemke, Karlsruhe Institute of Technology (KIT), Germany

17:00 – 17:30  
**First stage in flash sintering of zirconia based ceramics**  
Paul Carry, SIMaP Laboratory, France

17:30 – 18:00  
**Effect of (external) electric fields on heterogeneous solid state reactions – Special role of grain boundary diffusion**  
Carsten Korte, Forschungszentrum Jülich GmbH, Germany

18:00 – 18:30  
Coffee Break

18:30 – 19:00  
**Spark and plasma aided densification mechanisms during spark plasma sintering of ceramic powders**  
Rachman Chaim, Technion–Israel Institute of Technology, Israel

19:00 – 19:30  
**The modification of the temperature gradient in a large sample sintered by SPS**  
Mirva Eriksson, Stockholm University, Sweden

19:30 – 21:00  
Dinner

21:00 – 22:00  
Social Hour
Tuesday, March 8, 2016

07:30 – 08:30 Breakfast

Session 3: Flash – Various (Experimental)
Session Chair: Antti Makinen, Office of Naval Research, USA

08:30 – 09:00 Field and thermal factors in field–assisted consolidation of powder materials
Eugene Olevsky, San Diego State University, USA

09:00 – 09:30 Direct microwave sintering of gamma–alumina powder: Effect of alpha seeding and magnesia doping
Paul Carry, SIMaP Laboratory, France

09:30 – 10:00 Phase transformations in real time during flash
Jean–Marie Lebrun, University of Colorado, USA

10:00 – 10:30 Coffee Break

10:30 – 11:00 Role of defects in electric–field–assisted sintering
Steve Hellberg, Naval Research Laboratory, USA

11:00 – 11:30 Flash sintering of complex oxides
Luis Perez–Maqueda, Materials Institute, Spain

11:30 – 12:00 Coffee Break

12:00 – 12:30 Electric field–assisted flash sintering of fine–grained and high–permittivity CaCu$_3$Ti$_4$O$_{12}$ electroceramics
Lílian M. Jesus, University of São Paulo, Brazil

12:30 – 13:00 Flash sintering of ZnO, TiO$_2$ and other oxides: The origin of onset flash and effects of atmosphere, doping and particle size
Jian Luo, University of California San Diego, USA

13:00 – 13:30 Estimating ionic conductivity during flash sintering of 8ysz
Daniel Marinha, Saint–Gobain CREE, France

13:30 – 14:30 Lunch

14:30 – 19:00 Afternoon guided excursion to the Templar Castle (Convento de Cristo), a UNESCO World Heritage Site

19:30 – 21:00 Dinner on your own

21:00 – 22:00 Social Hour
Wednesday, March 9, 2016

07:30 – 08:30 Breakfast

**Session 4: Flash and SPS – Various**
Session Chair: Lawrence Kabacoff, USA

08:30 – 09:00 *Flash sintering of glass containing alumina bodies*
Mattia Biesuz, University of Trento, Italy

09:00 – 09:30 *The influence of doping on flash sintering condition in SrTi_{1-x}Fe_xO_{3-δ}*
Neta Shomrat, Technion, Israel

09:30 – 10:00 *Electric field effects on grain boundary formation and grain growth*
Klaus van Benthem, University of California Davis, USA

10:00 – 10:30 Coffee Break

10:30 – 11:00 *Flash obviates constrained sintering*
Rishi Raj, University of Colorado Boulder, USA

11:00 – 11:30 *Electrical field effects in spark plasma sintering of hyperstoichiometric UO_2*
Marco Cologna, European Commission, Joint Research Centre (JRC), Institute for Transuranium Elements (ITU), Germany

11:30 – 12:00 *Low–temperature spark plasma sintering of transparent ceramics by using SiC molding set*
Byung–Nam Kim, National Institute for Materials Science, Japan

12:00 – 12:30 *Electric current as a driving force for interphase growth in spark plasma sintered dielectric composites*
Catherine Elissalde, ICMCB–CNRS, France

12:30 – 13:00 *Discoloration of spark–plasma–sintered transparent MgAl_2O_4 spinel*
Koji Morita, National Institute for Materials Science, Japan

13:00 – 14:30 Lunch

**Session 5: SPS – Various**
Session Chair: Claude Estournès, Université de Toulouse; UPS, INP; Institut Carnot Cirimat, France

14:30 – 15:00 *Engineering of lightweight ceramic composites by spark plasma sintering*
Oleg Vasylkiv, National Institute for Materials Science, Japan
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>15:00 – 15:30</td>
<td>Development of electric current activated/assisted sintering (ECAS/SPS)</td>
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<td>Salvatore Grasso for Yoshio Sakka, National Institute for Materials Science, Japan</td>
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<tr>
<td>15:30 – 16:00</td>
<td>Benefits of SPS sintering on microstructure and piezoelectric properties of KNN–based ceramics</td>
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<td>Florian Jean, GREMAN, France</td>
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<td>16:00 – 16:30</td>
<td>Coffee Break</td>
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<tr>
<td>16:30 – 17:00</td>
<td>Generating MgAl$_2$O$_4$ whiskers using carbothermic reactions and SPS/FAST</td>
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<td>Anton Salomon, TU Bergakademie Freiberg, Germany</td>
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<tr>
<td>17:00 – 17:30</td>
<td>The mechanisms of field assisted sintering in metallic systems</td>
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<td>Johannes Trapp, TU Dresden IfWW, Germany</td>
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<tr>
<td>17:30 – 18:00</td>
<td>Microscopic densification mechanisms of metallic systems by spark plasma sintering</td>
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<td>Jean–Philippe Monchoux, Centre d’élaboration de matériaux et d’études structurales, France</td>
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<td>18:00 – 18:30</td>
<td>Coffee Break</td>
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<tr>
<td>18:30 – 19:00</td>
<td>Exploring length scale–property relationships in dense nanocrystalline materials</td>
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<td>Javier Garay, University of California, San Diego, USA</td>
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<td>19:00 – 19:30</td>
<td>SPS for chemical preparations</td>
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<td>Ihor Veremchuk, Max Planck Institute for Chemical Physics of Solids, Germany</td>
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<td>19:30 – 20:00</td>
<td>Ceramics of potassium sodium niobate by field–assisted sintering techniques: Spark plasma sintering versus spark plasma texturing</td>
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<td>Paula Maria Vilarinho, University of Aveiro, Portugal</td>
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<tr>
<td>20:00 – 21:00</td>
<td>Dinner</td>
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<tr>
<td>21:00 – 22:30</td>
<td>Poster Session / Social Hour</td>
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Thursday, March 10, 2016

07:30 – 08:30  Breakfast

**Session 6: Techniques, Methods and Simulations–I**
**Session Chair:** Michael Bakas, Army Research Office, USA

08:30 – 09:00  Microstructure evolution in spark plasma sintered hafnium–tantalum carbides
Ben Boesl, Florida International University, USA

09:00 – 09:30  Consolidation behavior of bulk amorphous glasses and foils: The effect of current on devitrification kinetics
Olivia A. Graeve, University of California, San Diego, USA

09:30 – 10:00  Processing high strength low oxide and metal impurity ZrB₂ ceramics using boron carbide and spark plasma sintering
Erica L. Corral, University of Arizona, USA

10:00 – 10:30  Coffee Break

10:30 – 11:00  Hybrid heated FAST/SPS with additional voltage support
Jan Raethel, Fraunhofer IKTS, Dresden, Germany

11:00 – 11:30  A dynamic bifurcation criterion for thermal runaway during the flash sintering of ceramics
João Gustavo Pereira da Silva, TUHH, Germany

11:30 – 12:00  Coffee Break

12:00 – 12:30  Hybrid heated FAST/SPS with additional voltage support
Jan Raethel, Fraunhofer IKTS, Dresden, Germany

12:30 – 14:00  Lunch

**Session 7: Techniques, Methods and Simulations–II**
**Session Chair:** Olivier Guillon, Forschungszentrum Jülich GmbH, Germany

14:00 – 14:30  Field effects during consolidation of metallic powders
Brandon McWilliams, US Army Research Laboratory, USA

14:30 – 15:00  Microwave and flash processing of functional materials: Are there (m)any similarities?
Bala Vaidhyanathan, Loughborough University, United Kingdom

15:00 – 15:30  Flash sintering: New opportunities
Salvatore Grasso, Queen Mary University of London (QMUL), United Kingdom
<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker/Institution</th>
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<tbody>
<tr>
<td>15:30 – 16:00</td>
<td>Ceramics sintering and shaping using the electrical field assisted sintering method</td>
<td>Amiya Mukherjee, University of California, USA</td>
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<td>16:00 – 16:30</td>
<td>Coffee Break</td>
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<td>16:30 – 17:00</td>
<td>Spark plasma sintering: Comparison between a fully coupled process numerical simulation and experimental data</td>
<td>David Martins, CEMEF / CIRIMAT / SAFRAN, France</td>
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<tr>
<td>17:00 – 17:30</td>
<td>Growing larger: Scaling up during spark plasma sintering of high-temperature ceramics</td>
<td>Oleg Vasylkiv, National Institute for Materials Science, Japan</td>
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<td>17:30 – 18:00</td>
<td>Energy coupled to matter for field-assisted processing</td>
<td>Raymond Brennan, U.S. Army Research Laboratory, USA</td>
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<td>18:00 – 18:30</td>
<td>Coffee Break</td>
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<td>18:30 – 19:00</td>
<td>Energy coupled to matter for field-assisted processing</td>
<td>Raymond Brennan, U.S. Army Research Laboratory, USA</td>
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<tr>
<td>19:00 – 19:30</td>
<td>Field assisted sintering: Challenges in scale-up from buttons to body armor</td>
<td>Christopher D. Haines, US Army ARDEC, USA</td>
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<tr>
<td>19:30 – 21:30</td>
<td>Banquet followed by Social Hour</td>
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Friday, March 11, 2016

07:30 – 08:30  Breakfast

Session 8: Innovative Materials
Session Chair: Rolf Janssen, TUHH, Germany

08:30 – 09:00  Modelling and FEM simulation of electric field assisted sintering of tungsten carbide (WC)
Sree Koundinya Sistla, RWTH–Aachen University, Germany

09:00 – 09:30  Spark plasma sintering: From the thermal gradient to advanced ceramic composites
Dmytro Demirskyi, Nanyang Technological University, Singapore

09:30 – 10:00  Densification of dense nano crystalline zinc oxide under electric field
Olivier Guillon, Forschungszentrum Jülich GmbH, Germany

10:00 – 10:30  Coffee Break

10:30 – 11:00  Features of grain growth and grain boundary formation under microwave and spark plasma sintering conditions
Andrey Ragulya, Institute for Problems of Materials Science (IPMS), Ukraine

11:00 – 11:30  Fabrication of a vitreous porcelain by conventional sintering and spark plasma sintering
Wirat Lerdprom, Imperial College London, United Kingdom

11:30 – 12:00  Application of microwave energy to consolidate titanium powder
Christopher Haines, US Army ARDEC, USA

12:00 – 12:30  Modification of the interdiffusion process in the Fe–Al system by SPS and field assisted sintering
Hanka Becker, Technical University Bergakademie Freiberg, Germany

12:30 – 13:00  Application of steel as an alternative tool material for field assisted sintering in SPA
Alexander Laptev, Forschungszentrum Julich GmbH, Germany

13:00 – 13:30  Abnormal grain growth in pressure assisted sintering of BaLa4Ti4O15
Ana Senos, University of Aveiro/ CICECO, Portugal

13:30  Lunch and Departure
1. **Flash sintering of SrTiO$_3$**  
   Fabian Lemke, KIT, Germany

2. **Flash sintering of TCP bioceramics: Effect of particle size and influence on $\beta \rightarrow \alpha$ transition**  
   Matteo Frasnelli, DII - University of Trento, Italy

3. **FAST sintering of alumina, spinel and yttria-stabilized zirconia three-phase composites**  
   David Kok, University of California, Irvine, USA

4.  

5. **Fast one-step synthesis and sintering of materials promoted by electric fields**  
   Lilian M. Jesus, University of São Paulo, Brazil

6.  

7.  

8. **Observations on Flash Sintering of Uranium Dioxide**  
   Kenneth J. McClellan, Los Alamos National Laboratory, USA

9. **Microstructure and mechanical properties of Spark Plasma Sintered tungsten-copper–zinc composites**  
   Thabiso Langa, Tshwane University of Technology, South Africa

10. **Self-organized structure in current-activated pressure-assisted densification (CAPAD)**  
    Sebastian Angst, University of Duisburg-Essen, German

11.  

12.  

13.  

14.  

15. **Growth behavior of faceted Na$_1$/2Bi$_1$/2TiO$_3$-BaTiO$_3$ grains in single and two-step sintering in support for the microstructural evolution principle**  
    Seok-Young Ko, Korea Advanced Institute of Science and Technology (KAIST), South Korea