SYMPOSIUM FF06

Advances in the Fundamental Understanding and Functionalization of Reactive Materials
December 2 - December 5, 2019

Symposium Organizers
Sili Deng, Massachusetts Institute of Technology
Alain Esteve, Laboratoire d'Analyse et d'Architecture des Systems
Lori Groven, South Dakota School of Mines and Technology
Robert Reeves, Lawrence Livermore National Laboratory

* Invited Paper

SESSION FF06.01: Reactive Behavior and Material Properties I
Session Chairs: Lori Groven and Travis Sippel
Monday Morning, December 2, 2019
Hynes, Level 3, Room 308

10:30 AM *FF06.01.01
The Early Stages of Subcritical Reactions in Al:Ni Mulilayers Studied by Combined Nanocalorimetry and Sub-Millisecond X-Ray Diffraction Tobias Neuhauser1, Gemma Tinti2, Harald Leiste1, Nicola Casati2, Michael Stüber2 and Karsten Woll1; 1Karlsruhe Institute of Technology, Germany; 2Paul Scherrer Institut, Switzerland

10:45 AM *FF06.01.02
Reactive Composites of Boron with Bismuth Fluoride and Bismuth—Preparation, Ignition and Combustion Siva Kumar Valluri, Karthick Kumarasen Ravi, Mirko Schoenitz and Edward L. Dreizin; New Jersey Institute of Technology, United States

11:00 AM *FF06.01.03
Reactive Materials for Ceramics Fabrication Alex Mukasyan; Notre Dame University, United States

11:30 AM *FF06.01.04
Glassy Amorphous Organic Energetics Rajen Patel1, Victor Stepanov1 and Hongwei Qiu2; 1U.S. Army Research Laboratory, United States; 2Leidos, United States

11:45 AM *FF06.01.05
Shape and Size Effects on the Oxidation of Aluminum Powders Pierre-Henry Esposito1, Thomas Neisius2, Renaud Denoyel1 and Marie-Vanessa Coulet1; CNRS-Aix Marseille Univ., France; 2CNRS, Aix-Marseille Univ., France

SESSION FF06.02: Applications of Reactive Materials I
Session Chairs: Sili Deng and Kyle Sullivan
Monday Afternoon, December 2, 2019
Hynes, Level 3, Room 308

2:15 PM FF06.02.02
Flexoelectricity in AlFluoropolymer Reactives Mikel J. Zaitzeff and Lori J. Groven; South Dakota School of Mines & Technology, United States

2:30 PM FF06.02.03
Development of Multimodal Antibacterial Surfaces Using Porous Amine-Reactive Films Incorporating Lubricant and Silver Nanoparticles Jeon Lee1, Jin Yoo1, Sanghyuk Wool2 and Kookheon Char1; 1Seoul National University, Korea (the Republic of); 2Chung-Ang University, Korea (the Republic of)

2:45 PM BREAK

SESSION FF06.03: Effects of Process on Reactive Materials Behavior
Session Chairs: Sili Deng and Kyle Sullivan
Monday Afternoon, December 2, 2019
Hynes, Level 3, Room 308

3:15 PM FF06.03.01
Preparation of Ti-Al-B Reactive Metal Powders from Titanium Borohydride Matthew Finn and Albert Epsteyn; U.S. Naval Research Laboratory, United States

3:30 PM FF06.03.02
Resodyn Acoustic Processing of Ni-Al for Cold-Spray Applications Ryan D. Macy, Michael J. Carter, Grant A. Crawford and Lori J. Groven; South Dakota School of Mines & Technology, United States

3:45 PM FF06.03.03
Nanoporous Metals from Thermal Decomposition of Transition Metal Dichalcogenides Swarnendu Chatterjee, Yawei Li, Saad Intikhab and Joshua Snyder; Drexel University, United States

4:00 PM *FF06.03.04
How Synthesis and Processing Parameters Affect Reactivity of Sonochemically-Generated Ti-Al-B Reactive Metal Powders Albert Epsteyn, Matthew Finn, Rohit Jacob and Brian Fisher; U.S. Naval Research Laboratory, United States

4:30 PM FF06.03.05
Spherical Composite Powders Prepared by Mechanical Milling Mehrnaz Mursalat, Daniel Hastings, Mirko Schoenitz and Edward L. Dreizin; New Jersey Institute of Technology, United States

SESSION FF06.04: Atomistic Modeling of Reactive Materials
Session Chairs: Albert Epsteyn and Alain Esteve
Tuesday Morning, December 3, 2019
Hynes, Level 3, Room 308

9:00 AM FF06.04.01
Growth of Polycyclic Aromatic Hydrocarbons During Carbon-Fiber Processing from Density Functional Theory Taishan Zhu1, Yanning Wang1,2, Jeramie J. Adams2, Jeffrey C. Grossman1 and Nicola Ferralis1; 1Massachusetts Institute of Technology, United States; 2Western Research Institute, United States

9:15 AM FF06.04.02
Modeling Energetics across Interfaces—Atomistic Molecular Dynamics Simulations of the Shock Loading of Reactive Nanolaminates Leah Granger1, Jon-Paul Maria2, Sergey Matveev3, Dana D. Diott2 and Donald Brenner1; 1North Carolina State University, United States; 2The Pennsylvania State University, United States; 3University of Illinois at Urbana-Champaign, United States
SESSION FF06.07: Reactive Behavior and Material Properties II
Session Chairs: Michael Abere and Michael Zachariah
Tuesday Afternoon, December 3, 2019
Hynes, Level 3, Room 308

3:00 PM FF06.07.01
Role of Grain Boundaries and Columnar Microstructures on Atomic Diffusion and Combustion in Ni/Al Nanolaminates Brandon Witbeck1,2 and Douglas E. Spearot1; 1University of Florida, United States; 2Air Force Research Laboratory, United States

3:15 PM FF06.07.02
Effect of Bilayers Arrangement on Self-Propagating Reactions of Thermite Reactive Nanolaminate Films Petra Hanusova and Jon-Paul Maria; The Pennsylvania State University, United States

3:30 PM *FF06.07.03
Microstructural and Mechanical Property Characterization of Reaction Synthesis-Produced Aluminum Metal Matrix Composites Ethan Sullivan1, Jacob Nuechterlain2, A. Polizzi2, Jeremy Iten1, Stephen Liu2 and Marcia Domack3; 1Colorado School of Mines, United States; 2Element 3D, United States; 3NASA, United States

4:00 PM FF06.07.04
Tailoring Reaction Temperature and Propagation Velocity in Ni/Al Multilayers—Understanding and Preventing Substrate Quenching Stefano Donzini, Maxence Menetrey, Jelena Wohlwend and Ralph Spolenak; ETH Zurich, Laboratory for Nanometallurgy, Switzerland

4:15 PM FF06.07.05
In Situ High-Speed Simultaneous X-Ray Phase Contrast Imaging and Diffraction for Dynamic Temperature and Morphology Measurements Ibrahim E. Gunduz; Naval Postgraduate School, United States

4:30 PM FF06.07.06
Effects of Post-Processing on Sol-Gel Synthesized Hard Magnetic Nanoparticles Keri A. Ledford, Jason H. Nadler and David Reid; Georgia Tech Research Institute, United States

SESSION FF06.08: Reactive Material Behavior at High Strain Rates
Session Chairs: Michael Grapes and Timothy Weihs
Wednesday Morning, December 4, 2019
Hynes, Level 3, Room 308

8:45 AM FF06.08.01
Microstructure and Mechanical Properties of Swaged High-Density Reactive Materials for Use in High-Velocity Impact Testing Jesse P. Grant1, Kevin McNesby2 and Timothy P. Weihs1; 1Johns Hopkins University, United States; 2US Army Research Laboratory, United States

9:00 AM FF06.08.02
Shock-Induced Reaction Synthesis of Boron Nitride from Mechanically Activated GaN and B Nano-Composite Wesley W Chapman1, Josh Pauls2, Metin Örnek1, Alex Mukasyan2 and Steve Son2; 1Purdue University, United States; 2University of Notre Dame, United States

9:15 AM *FF06.08.03
Tuning the Breakup of Reactive Fragment Materials Joseph Hooper; Naval Postgraduate School, United States

9:45 AM BREAK
SESSION FF06.09: Advanced Manufacturing of Reactive Materials
Session Chairs: Michael Grapes and Timothy Weihs
Wednesday Morning, December 4, 2019
Hynes, Level 3, Room 308

10:15 AM *FF06.09.01
Advances in Multimaterial 3D Printing Techniques A. M. Golobic,

10:45 AM *FF06.09.02
Aqueous Dispersion of Hydrophobic Pigments at High Solids Concentrations Manish K. Mishra1,2, Alexander Kitz3, Yijun Guo4, Antony V. Dyk5, James Boiling6, Ahmet Kusoglu7, Adam Z. Weber8, Kebede Beshah9, John Roper III10, Clayton J. Radke11 and Futiayani Wang12; 1University of California Berkeley, United States; 2Lawrence Berkeley National Laboratory, United States; 3The Dow Chemical Company, United States

11:00 AM FF06.09.03
Development of a Dual Nozzle Vibration Assisted 3D Printer with Applications to Reactive Materials Aaron Afrati, Monique S. McClain, Jeffrey F. Rhoads, Ibrahim E. Gunduz, Steve Son and John C. McCaw; Purdue University, United States

11:15 AM FF06.09.04
Using Architecture to Control Burn Properties of 3D Printed Al/CuO Thermite Structures Elliot R. Wainwright1,2, Kyle T. Sullivan3 and Michael Grapes4; 1Lawrence Livermore National Laboratory, United States; 2Johns Hopkins University, United States

11:30 AM FF06.09.05
A Comprehensive Study to Investigate the Supramolecular Interaction of Low-Molecular-Weight Gelators and Ultraviolet-Curable Monomers Zuoxin Zhou, Lea Santos, Christopher Tuck, Derek Irvine, David Amabilino and Ricky Wildman; University of Nottingham, United Kingdom

11:45 AM FF06.09.06
Model Materials to Develop Particle Chemistries for Reaction Assisted Additive Manufacturing Shane O. Arlington1, Shashank Vummidi Lakshman1, Sara C. Barron2, Jeffery B. DeLisio2, Juan C. Rodriguez2, Sharaud Narayanan3, Gregory Fritz3 and Timothy P. Weihs4; 1Johns Hopkins University, United States; 2Charles Stark Draper Laboratory, United States

SESSION FF06.10: Reactive Behavior and Material Properties III
Session Chairs: Joseph Hooper and David Kittle
Thursday Morning, December 5, 2019
Hynes, Level 3, Room 308

9:00 AM FF06.10.01
Interface Engineering with Metal Nanoparticles to Tune Ignition of Al/CuO Nanothermite Baptiste Julien, Jeremy Cure, Andrea Nicotelle, Severine Vivies, Alain Esteve and Carole Rossi; LAAS CNRS, France

9:15 AM FF06.10.02
The Transition between Oxidation Mechanisms for Aluminum Clusters and Nanoparticles Kyle R. Overdene1,2, Claron J. Ridge1,2, Yan Xin3, Tonya N. Jensen4, Scott L. Anderson4 and C. Michael Lindsay5; 1University of Dayton Research Institute, United States; 2Air Force Research Laboratory, United States; 3Florida State University, United States; 4The University of Utah, United States

9:30 AM *FF06.10.03
From Synthesis to Application—Al/Zr-Based Reactive Composite Metal Fuels Elliot R. Wainwright and Timothy P. Weihs; Johns Hopkins University, United States

10:00 AM BREAK

SESSION FF06.11: Reactive Material Experimental Techniques I
Session Chairs: Joseph Hooper and David Kittle
Thursday Morning, December 5, 2019
Hynes, Level 3, Room 308

10:30 AM FF06.11.01
Algorithm-Improved High Speed and Non-Invasive Confocal Raman Imaging of Two-Dimensional Materials Sachin Nair, Jun Gao, Qinong Yao, Michael H. Duax, Cees Otto and Frieder Mugele; University of Twente, Netherlands

10:45 AM FF06.11.02
Non-Contact Density and Thermal Conductivity Measurements of Encased Organic Thin Films and Thin-Film Explosives Elbara O. Ziade1, Christopher Perez2 and Eric C. Forrest3; 1Sandia National Laboratories, United States; 2Stanford University, United States

11:00 AM *FF06.11.03
Direct Observation of Shock-Induced Energetic Material Decomposition Keith A. Nelson; Massachusetts Institute of Technology, United States

11:30 AM FF06.11.04
Mass Spectrometric Study of the Formation of Key Intermediates in Iron Oxide Synthesis Flames Yasin Karakaya and Tina Kasper; University of Duisburg-Essen, Germany

11:45 AM FF06.11.05
Laser Ablation of Natural Carbonaceous Materials—Chemistry, Tunability and Applications Xining Zang, Cuiying Jian, Nicola Ferralis and Jeffrey C. Grossman; Massachusetts Institute of Technology, United States

SESSION FF06.12: Reactive Material Experimental Techniques II
Session Chairs: Edward Dreizin and Carole Rossi
Thursday Afternoon, December 5, 2019
Hynes, Level 3, Room 308

1:30 PM FF06.12.01
Characterization of Frontally Polymerizable Adhesives Daniel S. Camarda1, Matthew J. Lampe1, Alan J. Lesser2, Dennis Vollebregt3, Mark D. Minnichelli4 and Anna M. Mueller-Cristadoro5; 1University of Massachusetts Amherst, United States; 2Eindhoven University of Technology, Netherlands; 3BASF, Germany

1:45 PM FF06.12.02
A Reaction Violence Test for Safety Screening of Thermites Kyle T. Sullivan and Eric Avalos; Lawrence Livermore National Lab, United States

2:00 PM *FF06.12.03
In Operando High-Speed Microscopy and Thermometry to Track Reaction Propagation Dylan Kline1,2, Haiyang Wang2 and Michael R. Zachariah3; 1University of Maryland, United States; 2University of California, United States

2:30 PM BREAK

3:00 PM FF06.12.04
In-Depth Understanding of Reactive Aluminum/Aluminum Iodate Hexadecylate Nanoparticles via Advanced Material Characterizations Chi-Chin Wu1, Jianguo Wen2, Scott D. Walck3, Jennifer L. Gottfried4 and Rose A. Pesce-Rodriguez3; 1U.S. Army Research Laboratory, United States; 2Argonne National Laboratory, United States; 3Service Engineering Inc., United States
SESSION FF06.13: Continuum and Mesoscale Modeling of Reactive Materials
Session Chairs: Edward Dreizin and Carole Rossi
Thursday Afternoon, December 5, 2019
Hynes, Level 3, Room 308

3:15 PM FF06.13.01
Analytical Prediction of Spin Band Widths in Co/Al Nanolaminates
Michael J. Abere¹, Catherine Sobczak² and David P. Adams³; ¹Lawrence Livermore National Laboratory, United States; ²Sandia National Laboratories, United States

3:30 PM *FF06.13.02
3D Simulations of Reaction Front Dynamics in a 1:1 Co/Al Reactive Multilayer System
David Kittell, Michael J. Abere and David P. Adams; Sandia National Laboratories, United States

4:00 PM FF06.13.03
Modelling the Thermal Aging of Al/CuO Thermites in the Form of Nanolaminate Thin Films and Its Effect on Performances
Guillaume Lahiner¹, Mehdi Djafari Rouhani¹, Nicolas Richard³, Carole Rossi¹ and Alain Esteve¹; ¹LAAS-CNRS, France; ²CEA-DAM, France

4:15 PM FF06.13.04
A Benchmark Study of the Initiation and Propagation of Nanothermites Based on a Condensed Phase Diffusion/Reaction Scheme
Sarah M. Brotman¹,², Mehdi Djafari Rouhani¹,², Carole Rossi¹,² and Alain Esteve¹,²; ¹Laboratoire d'Analyse et d'Architecture de Systèmes, France; ²Centre National de la Recherche Scientifique, France