Center for Research in Extreme Batteries

Dr. Cynthia Lundgren, ARL
The Future of Munitions Batteries Workshop
Dec 7-8, 2016
**Goal:**
To foster and accelerate collaborative research in advanced battery materials and technologies and characterization techniques

**Focus:**
Batteries for extreme performance, environments and applications
(e.g. Defense, space and biomedical applications)

**Participants:**
Open to national and defense labs, universities, industry

**How is this different than other Battery Research Centers:**
- Focus on extreme performance, environments and properties
- Scope is fundamental research to manufacturing
- Open participation
- No fixed duration or fixed funding source

**Steering Committee**
Drs. Cynthia Lundgren, Kang Xu (ARL), Profs Eric Wachsman, Chunsheng Wang (UMD), Drs. Joe Dura, David Jacobsen (NIST), Dr William Acker (NYBEST), Dr Khalil Amine (ANL), Prof. Esther Takeuchi (Stonybrook U.)
**Battery Research Center Goals:**
- Development and discovery of new energy dense materials and technologies
- Transforming the new materials discoveries into practical energy storage devices and systems
- Leverage materials synthesis, characterization, analysis and modeling capabilities across partners
- Improved size, weight and power, and cost

**Collaborative Focus:**
- Batteries used in extreme applications
  - Flexible electronics, munitions
- Batteries with extreme properties
  - High energy and power density, extreme temps
- Batteries performing in extreme environments
  - space, in vitro, oil wells

**AFM In-situ Characterization of SEI**

**UMD-ARL Joint Project: Aqueous Electrolyte with Wide Echem Stability Window**
2 meetings/yr

- Annual Meeting – Review of CREB programs and plans
  - Next meeting – April 25 at UMD
  - In parallel with The Engineering Sustainability Workshop – Battery focus

- Focused Workshops in CREB topical areas
  - Characterization
  - Biomedical
Welcome to the Future of Munitions Batteries Workshop!

- Munitions Batteries: batteries for gun-firedmunitions, rockets, missiles, bombs, mines, and other exploding devices that are used for one-shot, non-maintainable, always-ready applications, roles that have traditionally been filled by reserve batteries.
- Purpose: to bring together scientists, technologists, program managers, system designers, and users from government agencies, research labs, private companies, universities, and program offices to understand, exchange information on, and discuss the present, the past, and the future of munitions batteries to bring about a new vision and new pathways for munitions battery technologies going forward.
- Style: informative, interactive, inter-disciplinary, synergetic, non-conventional, and forward-looking.

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<thead>
<tr>
<th>First Day (7 December 2016)</th>
<th>2:40 PM</th>
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<tbody>
<tr>
<td>3. Potentials of Active Battery Technologies for Munitions Applications</td>
<td>2:40 PM</td>
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<tr>
<td>ARL: Jeff Read - Feasibility of Using Active Batteries for Munitions Applications</td>
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<tr>
<td>Energizer: Matt Wendling - Active Battery Technologies for Munitions Applications</td>
<td>3:00 PM</td>
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<td>MaxPower: Steve Shanzt - Organic-Based R/T Liquid Reserve Technologies</td>
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<tr>
<td>Army-ARDEC: Karen Amabile - Power Requirements for Munitions: Present and Future</td>
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<td>Discussions (Auditorium; Running microphones at the ready)</td>
<td>4:00 PM</td>
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<td>Get-Together Dinner (Olive Garden, 14650 Baltimore Ave, Laurel, MD 20707; 301-284-0826)</td>
<td>7:30 PM</td>
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<tr>
<th>Second Day (8 December 2016)</th>
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<td>4. Non-Conventional Thinking and Technologies for Munitions Power</td>
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<tr>
<td>Army-ARL: Bruce Geil - Inside the Box: An Outside the Box Look at Power Requirements for New Concepts</td>
<td>8:00 AM</td>
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<td>Army-ARDEC: Guisseppe Di Benedetto - Nanomaterials and Additive Manufacturing for Munitions Power Sources</td>
<td>8:20 AM</td>
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<td>&gt; Break &lt;</td>
<td>9:40 AM</td>
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<td>Discussions (Continuation of this Session; Running microphones at the ready)</td>
<td>10:00 AM</td>
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<td>End of Workshop</td>
<td>12:00 PM</td>
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Status of CREB

Chunsheng Wang

Professor,
Department of Chemical & Biomolecular Engineering

http://www.cswang.umd.edu
cswang@umd.edu; (301) 405-0352
Status of CREB

May 2016: Center For Research in Extreme Batteries, a joint center between ARL and UMD was established in UMD.

Dec. 2016, Bylaws and Articles of Collaboration of CREB Consortium is being finalized.

CREB & CREB Consortium

Legal agreements (COOP, CRADA)

(Federal labs, Steering Committee)

Precompetitive seed programs
Competed among members

UMD Non profit
CREB Consortium
Status of CREB

CREB Consortium

Benefits
- Access to unique research solutions for defense, space, biomedical applications
- Exposure to new ideas and new collaborators
- More effectively bring multiple disciplines together to engage in collaborative projects with revolutionary results
- Access to unique research facilities and prototyping/manufacturing facilities
- Ability to formulate joint proposals with partners to pursue external funding
- Technology transition pathways available
- Access to all IP generated by CREB funding to members on a non commercial basis

Tiers of Membership
- Individual
- Universities and National Lab/DoD Lab - organizational Membership
- Industry Organizational Member
  - Tiered membership fee/income of organization
  - Industry Consortium - threshold member fee

Industrial Consortium: Advisory body to Steering Committee on industry related seed pre-competitive research programs funded by membership fees
Status of CREB

May, 2016: UMD, ARL & NIST Jointly Supported 4 Seed Grants

1. Imaging all-solid-state batteries at extreme temperatures
   PI: Marina Leite, Assistant Professor, Dept. of Materials Science and IREAP, UMD
   Co-PI: Albert Davidov, Leader of Functional Nanostructured Materials Group, NIST

2. Neutron Probe Study of Lithium Metal Anode in Garnet Based Solid-State Li-S Batteries
   PI: Liangbing Hu, Assistant Professor, Department of Materials Science, UMD
   Co-PI: Robert Gregory Downing, Chemist, Materials Measurement Lab., NIST

   PI: Yifei Mo, Assistant Professor, Department of Materials Science, UMD
   Co-PI: Terrence J. Udovic, Senior Scientist, Center for Neutron Research, NIST

4. Interfacial structure characterization of water-in-salt electrolyte for high energy aqueous batteries
   PI: Chunsheng Wang, Professor, Dept. of Chemical and Biomolecular Eng., UMD
   Co-PI: Joseph Dura, Center for Neutron Research, NIST
   Co-PI: Oleg Borodin, Electrochemical Branch, ARL
Path Forward

Refining/Redesigning CREB Logo

Lunching new CREB website
(current CREB website: creb.umd.edu)

Working with NIH on Biomedical Batteries

*Problem identification:* Workshops/conferences/working groups/advisory panels
(RFIs – R13 Conference Grant Applications)

*Solution implementation:* Multi-agency agreements for biomedical battery research,
Grants/Contracts; Peer reviewers

Working with DoD on extreme safe batteries
High energy aqueous rechargeable batteries
High energy all solid state Li-ion batteries