We’ll be starting in just a few minutes….

Tell us…

What topics are you interested in for future webinars?

Please send your response to the webinar organizers via the question box.
Lessons from the Field: Real World Applications that Inform R&D

February 5, 2019
3:00 – 4:00 PM EST
Clara Asmail

U.S. Department of Energy Office of Technology Transitions
• 17 world-class institutions that constitute the most comprehensive research and development network of its kind.

• An enduring science and technology powerhouse comprised of more than 20,000 scientists and engineers who deliver new discoveries and provide world-class technological capabilities.
3-D printed house in Oak Ridge highlights the possibilities of new manufacturing technologies.

Nanosys partnered with LBNL, 3M, and LG to develop Quantum Dot Enhancement Film that offers displays with 50% wider color spectrum at a comparable price without using more energy.

PNNL’s mobile Smartphone Microscope allows anyone with a smartphone to explore tiny objects for as little as 5¢. It slips over the smartphone and can be 3D printed.

LANL’s expertise in nuclear weapons helped P&G engineer a better diaper.

LLNL’s MIR is a compact, low-cost, low-power radar used for sensing nearby objects and measuring distances between objects in proximity.
SNL, LANL, LLNL, & NETL contributed to shale gas technology that significantly improved US energy independence.

NETL developed a user-friendly, flexible, and reliable tool to effectively communicate spatial data, as well as the data’s uncertainties.

National laboratories are drivers of new wind energy technologies.

Argonne National Lab’s battery cathode design helps powers EVs.

Ames’ Lab lead-free solder alloy is the world wide market leader.
Fermilab designed the first proton accelerator for cancer treatment.

Approximately 50 million nuclear medicine procedures are performed each year worldwide. BNL developed the Tc-99m generator and FDG used in PET scanning.

ORNL was an early leader in the use of ion implantation for semiconductor processing and artificial joint surface treatment.
The Office of Technology Transitions was created to expand the commercial impact of the DOE’s portfolio of R&D activities.

- Stakeholder Engagement
- Streamlining policies and procedures
- Elevating Best Practices
- Elevating Visibility

Energy.gov/technologytransitions
Achieving High-Impact Outcomes

• OTT coordinates activities across DOE programs, NNSA, field offices, national laboratories, ARPA-e, and DOE support offices as well as with other federal agencies

• Coordination reduces redundancies and improves likelihood and speed of outcomes toward technology transfer and commercial development of DOE’s research outputs

Prioritizing stakeholder engagement strengthens the national laboratories’ capabilities and the researchers’ competencies in engaging with industry and other partners

• Reducing barriers to industry engagement with the national laboratories

• Facilitating engagement for the transfer of technologies from the laboratories to the private sector for commercialization

Coordinating Facilitating Accelerating
Coordinating with Programs, GC, Labs and other support offices to develop:

- Alternate CRADA Clause Library
- Guidance on timing and sufficiency of CRADA Final Reports
- Guidance on Equity as Compensation within IP License Agreements
- Sharing best practices for patent licensing
- Agreements for Technology Commercialization (ACT)

and other policies related to TT
Factors Discouraging Some Sponsors of R&D at Labs using CRADA, SPP or User Agreements:

- Advanced Payments
- Indemnification
- Guaranteed Performance – vs – Best Effort
- Certain Reserved Government Rights to IP
Agreements for Commercializing Technology (ACT)

- M&O Contractor can negotiate business-friendly terms with third party clients in flexible agreements.
- Fast DOE approval of SoW / resource allocation - No DOE approval of agreement or business terms needed.
- Contractor may choose to accept certain levels of risk to carry out work for funding clients → payment terms, project deliverables, milestones, etc.
- Contractor can receive higher fees for work, as negotiated, based on risks and contributions of parties.
- IP rights distribution as negotiated with parties.
- Government use license is replaced with research and data rights license.
The TCF provides matching funds with private partners to promote promising energy technologies for commercial purposes

OTT manages the execution of the Technology Commercialization Fund (TCF), as mandated by Sec 1001 of EPAct 2005

- **FY16**: $19.7M -- 54 projects funded at 12 national labs ($15.9M), including matching funds ($16.9M) from 52 private-sector partners
- **FY17**: 54 projects funded at 12 national labs ($19M), with matching funds ($34M) from more than 30 private-sector partners
- **FY18**: 64 projects from 10 national labs ($20M)

**For FY 2019:**

Conducting the fourth round of funding for TCF through solicitation of proposals from the national laboratories

Continue execution of a TCF evaluation, which will track the FY 2016, 2017 and 2018 projects to assess processes/management and to ascertain program outcomes and effectiveness

Monitor the progress of activities funded in previous rounds
Connecting Investors to Lab Subject Matter Experts & IP

- Ask a question
  Our energy technology experts will help answer questions. Find experts by searching for technologies and keywords.
  Ask a National Lab Expert

- Learn how to partner
  Each national laboratory has unique technical expertise and user facilities. Learn about each lab and contact the technology transfer point of contact to learn more.
  Learn about types of agreements

- Explore technologies
  Locate technologies developed with DOE funding and available for licensing. When you find a technology you are interested in, contact the lab directly.
  Search technologies and patents

- Discover a Lab
  Each national laboratory has unique technical expertise and user facilities. Learn about each lab and contact the technology transfer point of contact to learn more.
  Profiles for over 20 locations

https://search.labpartnering.org/
Energy I-Corps: Bridging the Lab/Industry Knowledge Gap

Enhancing Capabilities of Researchers and Technology Transfer Offices

Trains scientists how breakthrough discoveries can transition into high-impact, real-world technologies for commercialization by the private sector.

Aimed at accelerating the transfer of energy technologies from national laboratories to the commercial market.

DOE-tailored version of successful NSF I-Corps program adopted across many agencies. DOE co-led establishment of current Community of Practice through OSTP.

- 10 National Labs participating
- Sixth class began October 2017
- Expansion to NE, EM, OE for 6th class
- 63 teams, more than 63 industry mentors and more than 4500 customer discovery interviews
- At least 5 teams have incorporated or launched a new small business
- $10 million in follow-on funding
- Exploring privately-funded teams

Energy.gov/technologytransitions
For More Information:

Clara Asmail
Deputy Director for Policy & Practice
Clara.Asmail@hq.doe.gov
202.586.5471
Patrick Blanchard
Ford Motor Company
IACMI - Project 3.2
Advanced Carbon Fiber Prepreg for High Performance Components with Complex Geometries
Dave Bank – Dow Polyurethanes R&D
on behalf of the 3.2 Team
Feb 5th, 2019
Fuel Economy Trends: Where Do Composites Have a Role?

https://www.epa.gov
Implementation of lightweight material solutions has become a key enabler for meeting current and future fuel economy targets.
Ford/Dow/DowAksa project proposal as lead automotive project in proposed new NNMI.

NNMI will be leveraged to scale up and develop high volume carbon fiber composite solutions.
IACMI Provides Production-relevant Environments for Innovation

IACMI facilities service the composites supply chain

- Indiana Manufacturing Institute
- Laboratory for Systems Integrity and Reliability at Vanderbilt University (LASIR)
- Composite Materials and Structures Center at Michigan State University
- Carbon Fiber Spinline Laboratory at the University of Kentucky
- Composites Laboratory at UDRI
- Carbon Fiber Technology Facility at ORNL
- Laboratory for Systems Integrity and Reliability at Vanderbilt University (LASIR)
- Scale-Up Research Facility (SURF)
- Composites Manufacturing and Education Technology Facility (CoMET) at NREL
- Fibers and Composites Manufacturing Facility at the University of Tennessee, Knoxville
- Manufacturing Demonstration Facility
- Full-scale production implementation
- Prototyping & testing
- Establishing business viability
- Modeling & simulation
- Composites Recycling Technology Center
- Utah Advanced Materials and Manufacturing Initiative
- Composites Prototyping Center

Regional partner
State partner
State with IACMI members
IACMI Creates a Community for Composites Innovation

IACMI improves U.S. security and manufacturing competitiveness by

1. providing production-relevant environments for innovation
2. establishing a supply chain-based framework for decision making
3. training the workforce in support of the needs of the advanced polymer composites industry

$25.2 BILLION: Composites’ annual contribution to the U.S. economy

Source: ACMA 2019 Industry Report

160+ IACMI MEMBERS
50%+ Small & Medium Organizations
Developing Industry Solutions via IACMI Partnerships

1. SURF Prototype production
2. Flow simulation
3. Mechanical performance simulation
4. Part dimensional simulation
5. Verification of models and mechanics
6. Bonding & assembly
7. Painting & decorating
8. New carbon fiber materials
IACMI Project 3.2 Summary

• **Title:** Optimized Carbon Fiber Production to Enable High Volume Manufacturing of Lightweight Automotive Components

• **Challenge:** Carbon fiber consistency and production rate, intermediate production & mechanical performance, molding cycle times, recycle of in-plant scrap

• **Approach:** OEM-Material Supplier-Tier 1 joint development of supply chain to develop, integrate and application-optimize carbon fibers, resin, composite intermediates, molding methods, automation, modeling, and waste reduction

• **Impact:** Deploy carbon composite components on multiple 100k+ units/yr vehicle platforms.

  • 3-year Vehicles Project 3.2
  • TRL/MRL Impact: from 4-5 to 7
  • Ford, Dow, DowAksa, MSU, ORNL, Purdue, UT.
  • CSP (Tier 1 implementation partner)
### Key Material Properties & Processing Requirements

<table>
<thead>
<tr>
<th>Process/Property</th>
<th>Required performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMC storage stability</td>
<td>50 days at ≤ 40 °C</td>
</tr>
<tr>
<td>Molding</td>
<td>Compression molding</td>
</tr>
<tr>
<td>Mold temperature</td>
<td>145 - 155 °C</td>
</tr>
<tr>
<td># of parts molded between applications of external mold release</td>
<td>1000</td>
</tr>
<tr>
<td>Cure speed (resin cure kinetics)</td>
<td>&lt; 2 min @ 150 °C (DSC)</td>
</tr>
<tr>
<td>Degree of cure after molding</td>
<td>&gt; 95%</td>
</tr>
<tr>
<td>Cured Tg</td>
<td>150 – 160 °C (DMA)</td>
</tr>
</tbody>
</table>
**Target:** Components exhibiting complex 3-D geometries including closure panels for replacement of structural light weight metal castings (AL, Mg)

**Objectives:** Invent random fiber molding compound & demonstrate key CTQ’s comparable to cast aluminum and processability conducive to large part 3D molding
Lincoln MKS used for surrogate design and prototyping

CF-SMC Inner + Glass Fiber LD-SMC Outer
• Replaced glass fiber SMC inner panel with carbon fiber SMC.
• Replaced standard density glass fiber SMC outer with low density glass fiber SMC.
• All other hardware and joining techniques were unchanged.
<table>
<thead>
<tr>
<th>Test</th>
<th>Result units</th>
<th>Baseline vs CF SMC</th>
<th>Baseline vs Optimized CF SMC</th>
<th>Pass/ Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Corner Deflection</td>
<td>Displacement -Z (mm)</td>
<td>35.8%</td>
<td>28.3%</td>
<td>Pass</td>
</tr>
<tr>
<td>Waterfall Deflection</td>
<td>Displacement Z (mm)</td>
<td>47.5%</td>
<td>24.0%</td>
<td>Pass</td>
</tr>
<tr>
<td>Latch Loads</td>
<td>Displacement Normal to Surf. (mm)</td>
<td>45.6%</td>
<td>36.3%</td>
<td>Pass</td>
</tr>
<tr>
<td>Torsional Rigidity</td>
<td>Angle / meter (degrees/m)</td>
<td>55.0%</td>
<td>30.5%</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Lincoln MKS Decklid Masses

**STD GF inner**
- Inner Mass: 4.89 Kg
- Yellow t: 2.25 mm
- Gray t: 4.00 mm
- Total mass: **10.5 Kg**
- Inner and outer skins not including steel reinforcements

**STD GF outer**

**CF inner**
- Inner Mass: 3.62 Kg
- Yellow t: 2.25 mm
- Gray t: 4.00 mm
- Total mass: **7.33 Kg**
- Inner and outer skins not including steel reinforcements

**LD GF Outer**

**CF inner**
- Inner Mass: 3.10 Kg
- Green t: 2.15 mm
- Pink t: 2.10 mm
- Blue t: 2.00 mm
- Red t: 2.50 mm
- Total mass: **6.81 Kg**
- Inner and outer skins not including steel reinforcements

- 30% reduction
- 35% reduction
Prototype Validation Studies

CF SMC Charge

Charge Pattern
Decklid Inner Molding Die

Decklid Trim Fixture

Cooling Fixture with Part

Part Holding Rack

<table>
<thead>
<tr>
<th>#</th>
<th>Charge Mass (kg)</th>
<th>Cure (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.90</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>4.72</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>5.03</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4.67</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>4.54</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>4.54</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>4.67</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>4.54</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>4.72</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>4.58</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>4.72</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>4.49</td>
<td>3</td>
</tr>
</tbody>
</table>
Prototype Assembly Process

Join steel reinforcements to inner via adhesive and Blind-rivets
(2) Steel hinge reinforcements
(6) Blind-rivets
73326/27 epoxy 2k adhesive
Steel latch reinforcement

Join CF inner and GF outer panel with adhesive and mastic
(2) Clip nuts
1.25mm glass beads
Mastic

Conductively primed and cured in an oven
132°C for 20 min

Paint oven simulated*
190°C for 30 min
180°C for 20 min
160°C for 35 min

Hinges and latch bolted to reinforcement studs
(2) Hinge
Latch

Trim added
Decklid Physical Test Setup

Latch Load

Torsional Rigidity

Front Corner Deflection

Waterfall Deflection
### Physical Test Results

<table>
<thead>
<tr>
<th>Test</th>
<th>Result units</th>
<th>Pass/Fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Corner Deflection</td>
<td>Displacement -Z (mm)</td>
<td>Pass</td>
</tr>
<tr>
<td>Waterfall Deflection</td>
<td>Permanent Set (mm)</td>
<td>Pass</td>
</tr>
<tr>
<td></td>
<td>Displacement Z (mm)</td>
<td></td>
</tr>
<tr>
<td>Latch Loads</td>
<td>Permanent Set (mm)</td>
<td>Pass</td>
</tr>
<tr>
<td>Torsional Rigidity</td>
<td>Angle / meter (degrees/m)</td>
<td>Pass</td>
</tr>
</tbody>
</table>

Lincoln MKS test vehicle fitted with prototype CF decklid inner / GF-SMC outer
Developing Industry Solutions via IACMI Partnerships

1. SURF Prototype production
2. Flow simulation
3. Mechanical performance simulation
4. Part dimensional simulation
5. Verification of models and mechanics
6. Bonding & assembly
7. Painting & decorating
8. New carbon fiber materials
THANK YOU
Dr. Stan Petrash

Henkel Corporation
Technologist-in-Residence Program: Henkel and BNL Cooperation

Dr. Stanislas Petrash
2019-02-05
Agenda

1. About Henkel
2. Our Technical Challenges
3. Working with DoE Labs
4. Focus on BNL
5. Way Forward
Henkel is a leading solution provider for adhesives, sealants and functional coatings in many different market segments:

**Packaging & Consumer Goods**
- Stronger cardboard adhesives, safer food packaging

**Transport & Metal**
- Lightweight anti-corrosion metal coating

**Electronics**
- Thermal adhesive for computer assembly, conductive paste for microchips

**General Industry**
- Better insulation for gas storage & transportation

**Consumer, Craftsmen**
- “Superglue” for plastics, eco-cement for construction

**Challenge:** Move away from “Edisonian” approach to product development, focus on emerging trends and fundamental science
What We Do

Emphasis on:

- real materials
- under real processing (\textit{in situ}) and operating conditions (\textit{in operando})
- using advanced characterization methods of Materials Science
How We Can Do More

Henkel AR and National Labs, run by US Dept. of Energy (DoE), have similar focus:

Complex, multidisciplinary research in applied science and engineering, targeted for advanced commercial applications

Image: DOE Office of Science, NSLS-II CFN User Meeting, May 2016
How We Can Do More: Working with DoE

- Largest supporter of Materials Science in the US
- Budget: $5.35 Billion in 2016
- Resources: >$775 million just in user facilities’ operating budget

DoE research targets the same global socio-economic challenges that are of interest to Henkel:

- **Materials:** Nano-materials, Bio-materials, Self-Assembly
- **Applications:** Renewable Energy (generation, storage and transportation), Advanced Electronics and Optics, Composites and 3D Printing
- **Methods:** In-situ, in-operando, in-vivo characterization
- **Big Data:** storage, analysis, simulations
Technologist-in-Residence Program

- The Technologist in Residence (TIR) Program pairs senior technical staff from national laboratories and companies to work together towards long-term strategic collaborative partnerships and impactful manufacturing solutions.

- The vision of the TIR Program is to catalyze strong national laboratory-industry relationships that result in significant growth in high-impact research and development.

DOE will convene a Council of Technologists, made up of the selected pairs and representatives throughout the lab enterprise. Through the Council of Technologists, selected pairs will work together to provide insight into all of the participating laboratories, and to provide feedback to DOE about optimizing lab-industry partnerships in the future.
Our TiR Journey

- Identified Brookhaven National Lab (BNL) as a strategic partner
  - Previous connections from National Synchrotron Light Source
  - Excellent capabilities at NSLS-II and CFN user facilities
  - Proximity to two major Henkel R&D Centers (NJ and CT)
- Collaborative work at BNL
  - Provided Henkel equipment for experiments at NSLS-II
  - Proprietary projects with CFN
  - Expanding scope of the projects beyond one beamline (currently working on SRX, FXI, BMM, CHX, CMS beamlines)
- Elected member of User Executive Committee at NSLS-II
Our TiR Journey

- Expanded to other DoE User Facilities:
  - Visit to EERE (Colorado) for Council of Technologists
    - Contact with EERE thermal materials testing lab to help with Henkel’s challenges with electrical mobility
  - User experiments at LBNL to complement BNL capabilities for X-ray characterization of matter
  - Contacts with LLNL and Sandia labs in the area of Additive Manufacturing
    - Two joint LDRD proposals with LLNL (unfortunately, not funded)
  - Visit to ORNL to take advantage of their Additive Manufacturing Center
Our TiR Journey

- Strengthening the ties with BNL
  - Funding of PhD student to work at NSLS-II and CFN facilities
  - 50/50 funding of postdoctoral fellow with NSLS-II to work on research area of mutual interest (Additive Manufacturing)
  - Building the instrumental capabilities for studies on industrial processes in-operando

- Future plans
  - Developing plans for Government/Industry/Academia Center for Additive Manufacturing
  - Possibility of Henkel “Implant Lab” within planned “Discovery Park” at BNL
Summary

- DoE National Labs are fantastic resource for industrial partners who are willing to spend time and effort to develop collaborations.
- TiR is an excellent program to “get to know” the capabilities of DoE.
- More diverse ways for interactions between DoE facilities and industry partners are desirable (Alternatives to CRADA, DoE non-profit foundation?)
Thank you!
Additional Resources

- Lab Partnering Service
- Office of Technology Transitions
Better Buildings Webinar Series

PRIORITIZING LABORATORIES TO MEET YOUR ENERGY GOALS
Tuesday, January 8, 2019 | 3:00 - 4:00 PM ET

LESSONS FROM THE FIELD: REAL WORLD APPLICATIONS THAT INFORM R&D
Tuesday, February 5, 2019 | 3:00 - 4:00 PM ET

STRAIGHT TALK: TALKING TO MULTIFAMILY TENANTS ABOUT UTILITY BENCHMARKING
Tuesday, May 7, 2019 | 3:00 - 4:00 PM ET

BETTER BUILDINGS, BETTER BODIES: STRATEGIES FOR HEALTH & WELLNESS
Tuesday, March 5, 2019 | 3:00 - 4:00 PM ET

SOLUTIONS FOR SMALL DATA CENTERS – AIR MANAGEMENT PACKAGES
Tuesday, June 4, 2019 | 3:00 - 4:00 PM ET

RETHINKING TRADITIONAL FINANCE: HOW EFFICIENCY-AS-A-SERVICE UNLOCKS NEW POTENTIAL FOR BUSINESS
Tuesday, April 2, 2019 | 3:00 - 4:00 PM ET
Better Buildings Webinar Series

BETTER BUILDINGS, BETTER BODIES:
STRATEGIES FOR HEALTH & WELLNESS

Tuesday, March 5, 2019  |  3:00 - 4:00 PM ET

Meet Better Buildings partners who are implementing design strategies in their buildings and sustainability plans focusing on the wellness, health, and productivity of the people inside them.
REGISTER NOW

2019 SUMMIT

JULY 10-11 | ARLINGTON, VA

IMPROVING AMERICA’S BUILDINGS THROUGH LEADERSHIP AND INNOVATION

BETTERBUILDINGSINITIATIVE.ENERGY.GOV/SUMMIT
**Today's Presenters**

<table>
<thead>
<tr>
<th>Name</th>
<th>Company</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Stan Petrash</td>
<td>Henkel Corporation</td>
<td><a href="mailto:stan.petrash@henkel.com">stan.petrash@henkel.com</a></td>
</tr>
<tr>
<td>Patrick Blanchard</td>
<td>Ford Motor Company</td>
<td><a href="mailto:pblanch3@ford.com">pblanch3@ford.com</a></td>
</tr>
<tr>
<td>Clara Asmail</td>
<td>U.S. DOE</td>
<td><a href="mailto:clara.asmail@hq.doe.gov">clara.asmail@hq.doe.gov</a></td>
</tr>
</tbody>
</table>

**DOE Program Leads**

<table>
<thead>
<tr>
<th>Name</th>
<th>DOE, Better Buildings Challenge</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eli Levine</td>
<td></td>
<td><a href="mailto:Eli.Levine@EE.Doe.Gov">Eli.Levine@EE.Doe.Gov</a></td>
</tr>
<tr>
<td>Bruce Lung</td>
<td></td>
<td><a href="mailto:Robert.Lung@EE.DOE.Gov">Robert.Lung@EE.DOE.Gov</a></td>
</tr>
</tbody>
</table>

**Program Support**

<table>
<thead>
<tr>
<th>Name</th>
<th>RE Tech Advisors</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kendall Sanderson</td>
<td></td>
<td><a href="mailto:ksanderson@retechadvisors.com">ksanderson@retechadvisors.com</a></td>
</tr>
<tr>
<td>Megan Krest</td>
<td></td>
<td><a href="mailto:mkrest@retechadvisors.com">mkrest@retechadvisors.com</a></td>
</tr>
</tbody>
</table>

Follow us on Twitter @BetterBldgsDOE