Latest Manufacturing Technologies for Low-cost, Energy-efficient Manufacturing of Advanced Polymer Composites

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What is IACMI?

- Operated by Collaborative Composite Solutions Corp, an independent not-for-profit
- Governed by a board of directors
- A wholly owned subsidiary of the University of Tennessee Research Foundation
- Headquartered in Knoxville, Tennessee
- Over 155 member consortium, including more than 125 industrial entities across supply chain
- $250M in funding with $70M from DOE and $180M from partners
Research and Development Partner for Industry

Bridging the Gap to Manufacturing

AMO: Advanced Manufacturing Office

- DOE Energy Innovation Hubs
- NSF Engineering Research Centers
- NSF I/UCR Centers
- SBIR/STTR
- R&D Projects
- R&D Facilities
- Technical Assistance
- NIST Manufacturing Extension Partnership

Technology Maturity (TRL; MRL; etc.)

Concept → Proof of Concept → Lab scale development → Demonstration and scale-up → Product Commercialization
IACMI – The Composites Institute has partnered with ACMA, the premiere composites industry association and Composites One for workforce training capabilities.

Technical Goals:
• Lower carbon fiber–reinforced polymer (CFRP) cost
• Reduce CFRP embodied energy
• Improve composite recyclability into useful products
IACMI-The Composites Institute Facilities

Colorado

Indiana

Tennessee

Ohio

Michigan
IACMI Focus Areas and Metrics

Application Areas
- Vehicles
- Compressed Gas Storage
- Wind

Focus Areas
- Energy
- Speed
- Recycling

Enabling Technology Areas
- Design
- Simulation
- Joining
- Nondestructive Evaluation
- Materials

+ $500M Capital Investment
Scale-up Across IACMI Core Partners

Solution spinning line
Carbon Fiber Technology Facility
Pre-preg production pilot/full scale
Pilot-scale PCM 750 ton press
Full Scale PCM 4,000 ton press

KY
TN
IN
TN
OH
MI
TN
OH
MI
Key IACMI Capabilities (300,000 sq.ft, $200 million in replacement value investment)
Ways to Partner with IACMI

1. RD&D Research Project
   A. Enterprise
   B. Technology Collaboration
   C. Topic-Specific

2. Membership
   A. Charter
   B. Premium
   C. Resource
   D. Consortium
Roadmapping Strategy

- Integrated R&D efforts across IACMI Technology Areas toward 5/-10-year targets

- Industry-led projects draw upon resources from one or more IACMI Technology Areas

- Eight cross-cutting subtopics help address full range of enabling technologies
Global vehicle production is growing
Why Lightweighting?

“Excess weight kills any self-propelled vehicle. There are a lot of fool ideas about weight . . . Whenever anyone suggests to me that I might increase weight or add a part, I look into decreasing weight and eliminating a part!” – Henry Ford, 1922

Every automotive manufacturer is pursuing lightweighting as a key strategy to reduce fuel consumption—irrespective of the powertrain technology pathway.
Weight reduction – Automotive, Mass Transit & Truck

- Performance
- Increased ‘customer value’ while staying within Corporate Average Fuel Economy (CAFÉ) limits
- Long term increase in fuel prices
- 6-8% (with mass compounding) increase in fuel economy for every 10% reduction in weight, everything else being the same

DOE, Carpenter, 2008
Big Area Additive Manufacturing for producing large scale composites – ground vehicle components, cars, bridges, wind mill blades etc..
Leverage Computing Power to Enhance Design Confidence

- Create Composites Virtual Factory HUB (cvfHUB)
- Develop platform for hosting and integration of commercial software tools for composites
- Provide end-to-end simulation for composites
- Correlate at multiple scales prediction and reality
- Make tools and knowledge available to entire value chain to enhance confidence and reduce cost
- Implementation is underway, rollout commences mid-2017
IACMI-The Composites Institute Facilities, Vehicle Scale Up Facility in Corktown Area of Detroit, Michigan

- Facility is shared by IACMI-The Composites Institute and LIFT Innovation Institute

- Co-located with LIFT, 9300 m² total
- Capitalization >$15M

- **Compression Press**
  - Schuler Press: 4000T, 3.7m x 2.4m platen
  - Thermosets & Thermoplastic
  - Infusion, compression

- **Injection Molding Cell**
  - Milacron Press: 3000T, 3m x 2.4m platen
  - 1-10kg shot size, 3 – 275kg dryers
  - Robotic handling
CGS Manufacture State of the Art

*Courtesy of Xperion*
Braid Offers Potential for Enhanced Safety and Reduced Mass
National Wind Technology Center (NWTC)

- High-performance simulation tools
- Wind resource assessment
- Wind forecasting
- Utility grid connectivity
- Economic analysis of turbine technology
- Full-scale structural testing
  - Blades
  - Dynamometer
  - Field testing
Wind Blade Challenges and Opportunities

- Reduction in hands-on labor
  - Automated fabric laying
  - Automated tape laying
- Transportation logistics
  - Segmented blades
- Recyclability
  - Thermoplastics?
- Field reliability of blades
  - In-process nondestructive evaluation
  - Structural testing
- Blade structural properties
  - Pultruded spar caps
- Time to market
  - Additive manufacturing—molds
IACMI Wind TA Composites Manufacturing and Education Technology (CoMET) Facility

- Manufacturing space focused on composite manufacturing innovation
- 55’ x 200’ – 10,000 sq. ft.
- Adjacent to blade test facility
- Full-scale blade component manufacturing
Full Scale Wind Blade Tooling

48.5m blade tip mold
    Courtesy GE

Large shear web mold
    Courtesy GE

Portion of 60m spar cap infusion mold
    Courtesy DowAksa
Workforce Training

- STEM Events
- Hands-On Events
- Intern Program
- Online Training (CCT)

Established workforce

TARGET: Mid-career/Students

Students
Federal Investment Will Catalyze a Composites Ecosystem in the Heart of US Manufacturing

- $70M - DOE
- $189M - Other
- 123 - Member Consortium
- 6 Core Partner States
- Strong Leadership
- 5 Technology Areas

$75% CFRP embodied energy savings
- 25%
- 50%

- 50%
- 75%

- 75%

80% FRP recycled and/or reused
95%

50% Production capacity

5 Years

10 Years
Thank you!

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