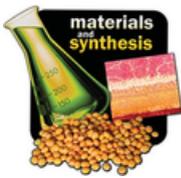




MULTIDISCIPLINARY RESEARCH PHILOSOPHY

The University of Delaware Center for Composite Materials (UD-CCM), located in Newark Delaware, has been an international leader in composites science and engineering research, education, and technology transfer for over 44 years. Founded in 1974, UD-CCM was one of the first centers at the university and is currently one of fifteen research centers in the College of Engineering. UD-CCM's multidisciplinary research philosophy encourages faculty, post-docs, professionals, and students from various science and engineering disciplines to work in a collaborative environment to address the needs of our sponsors.

Six research thrust areas describe Center interdisciplinary activities in composite materials:



Materials & Synthesis

This thrust addresses identification, creation, and tailoring of existing and next-generation materials through the control of microstructure at multiple scales, ranging from molecular to macro-scale. Advanced fibers, new polymers, sizings and nanomaterials are primary areas of interest.

- Rheology
- Cure Kinetics
- Glass Transition
- Computational Analysis
- Thermal Transport
- FTIR



Mechanics & Design

Work in this area focuses on understanding microstructure-property relationships to enable model-based design and optimization of materials and structures at multiple scales. It encompasses mechanics of materials at multiple scales, numerical methods, CAD/CAM, re-engineering, and new software design tools

- Modeling & Simulation
- Ballistics & Blast
- High Strain Rate & Dynamic Testing
- Micro-Mechanics
- CAS / CAE / CAM



Processing Science

Development of new composite manufacturing processes, understanding processing effects on microstructure-property relationship, models and simulations for virtual manufacturing for quality and affordability are the major thrusts in this area.

- Liquid molding
- Introduction
- Thermo Forming
- Autoclave
- Pultrusion
- Prepreg



Performance

In this thrust, research focuses on state-of-the-art testing and evaluation of a wide range of material properties, including static and dynamic thermo-mechanical properties, adhesion at multiple-scales, electromagnetic properties etc., on a wide range of structures from the nanoscale to full-scale prototypes. The work also addresses the development of new test procedures and equipment.

- Mechanical Testing
- Damage Tolerance
- Fatigue
- Environmental Testing
- Interphase Characterization
- Repair

PIONEERING INNOVATION EXCELLENCE

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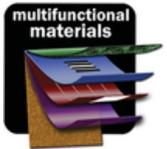
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Sensing & Control

Work in this area is aimed at developing sensors and devices to monitor composites from manufacturing to the end of service life. It also comprises development and validation of process control schemes using simulations and manufacturing workcells.

- Liquid Composite Molding Control
- CNT-based Health Monitoring
- Vibration Based Inspection
- Time Domain Reflectometry Flow & Cure
- Ultrasound Inspection



Multifunctional Materials

This thrust focuses on developing materials to accomplish multiple performance objectives in a single material system. It encompasses traditional composite materials that provide high specific stiffness, strength, and incorporates other functions such as energy absorption, electromagnetic properties, sensing and actuation, power harvesting and repair.

- Electro-Magnetic Structures
- CNT-based Composites
- Nano Composites
- Shear Thickening Fluids



Artificial Intelligence

This thrust focuses on building AI-driven platforms for inverse design and incorporating material-process-microstructure-performance (MP2) relationships. By leveraging physics informed artificial intelligence and machine learning approaches, the Center accelerates materials & process discovery, enhances performance, reduces weight and enables energy-efficient composite production.

- AI-driven platforms for inverse design
- Materials and Manufacturing process discovery
- Physics informed neural networks
- Multifunctional Applications

UD-CCM attracts faculty and students from the Departments of Chemical Engineering, Materials Science & Engineering, Civil & Environmental Engineering, Electrical & Computer Engineering, and Mechanical Engineering, as well as from the Departments of Mathematics, Physics & Astronomy, and Chemistry & Biochemistry in the College of Arts & Science and from the Accounting & MIS Department within the College of Business & Economics.

Our researchers conduct world-class research in each of these areas but also work in research teams at the interface between these disciplines to design and optimize new materials and processes that deliver performance and affordability. Our unique facilities enable our research teams to carry forward research ideas from basic science, through design and manufacturing to prototyping of fully functional affordable systems. Our multidisciplinary research philosophy captured in the six thrust areas provides the necessary scientific foundation to carry forward basic research, through its maturation phase into technology transition opportunities with our sponsors.



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