UNIVERSITY OF DELAWARE
CENTER FOR
COMPOSITE MATERIALS
Celebrating 50 Years

2024

INTERFACE SCIENCE

The University of Delaware Center for Composite Materials (UD-CCM) has over 30 years of experience in interface characterization and modification. The Interface Science laboratory hosts specialized equipment that helps researchers understand and tailor the mechanisms of adhesion between fiber and resin. This equipment also allows UD-CCM researchers to study the role adhesion at the filament length scale plays in determining macroscopic composite properties.

Key capabilities

Fiber Surface Modification

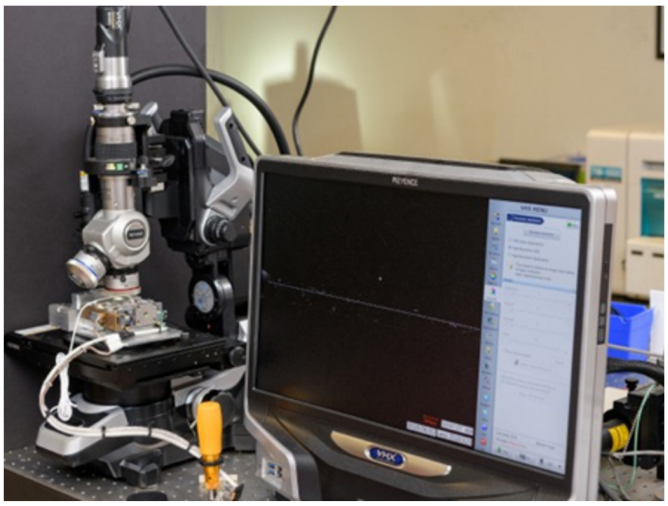
- Ozone Treatment
- Laboratory Scale Fiber Sizing Application System (CVD)
- Electrodeposition of Nanomaterials

Surface Characterization and Imaging

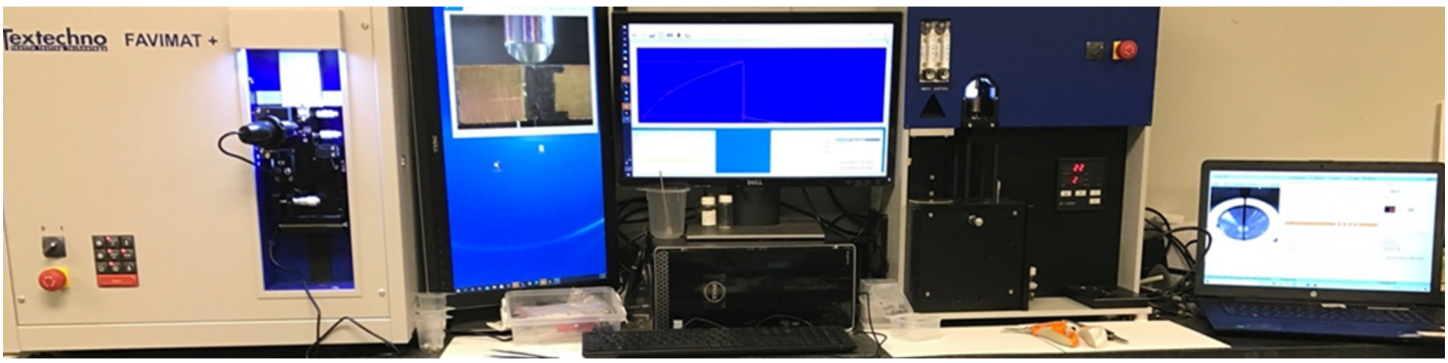
- Atomic Force Microscopy
- SEM Imaging (Hitachi TM4000)
- Laser Confocal Microscopy (Keyence VK Series)
- ATR FTIR Spectroscopy (Perkin Elmer)
- High-Speed IR Imaging
- Dynamic Contact Angle Measurements
- Renishaw Micro-Raman Spectroscopy Unit
- Bruker D8 Discover 2 Dimension Wide Angle X-Ray
- Shimadzu HPV-X2 Ultra-High Speed Camera

Micromechanical Testing

- Single Fiber Pullout Testing (Textechno)
- Sub-Zero/Elevated Temperature Pullout Testing
- In Situ Fiber Fragmentation Testing
- Quasistatic and High Strain Rate Microdroplet Test
- Automated Single Filament Testing (Dia-stron)



In situ fiber fragmentation testing station



Single fiber pullout specimen preparation and testing

PIONEERING INNOVATION EXCELLENCE

SINCE 1974

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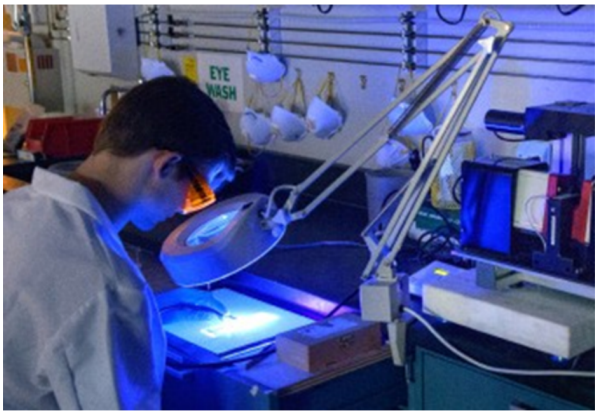
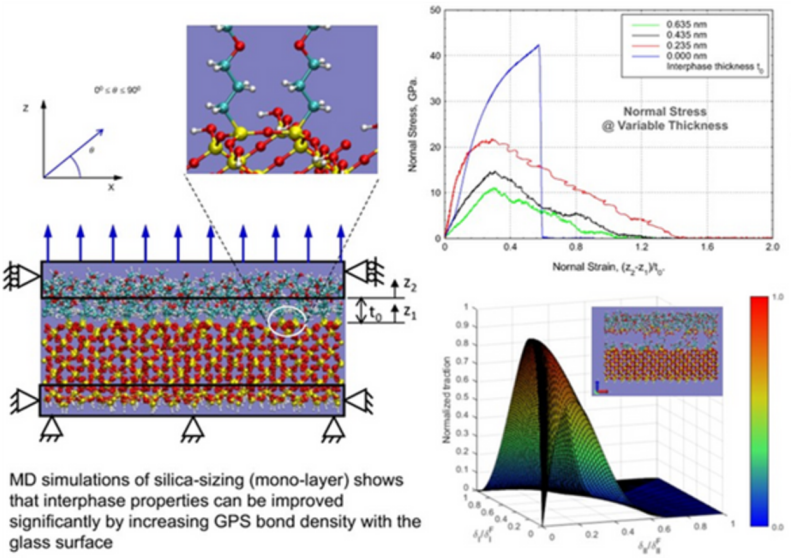
INTERFACE SCIENCE

Advanced computational tools and over 15 years of experience enable UD-CCM researchers to model composite performance from atomistic length scales to the continuum level. UD-CCM has 1,652 dedicated CPUs in UD's Community Cluster named Caviness. Molecular dynamics simulations are being conducted to study the influence of processing conditions on the composition and performance of the fiber/sizing/resin interphase as well as the effects on the interphase performance under multi-axial loading.

Predictions from these models are validated experimentally and provide critical inputs to continuum-level models at higher length scales. "Small changes in the composition of the fiber/resin interface, predictable by MD simulation, have a measurable impact on the macroscopic performance of the composite", according to Dr. Joseph Deitzel, Senior Scientist at UD-CCM. "By developing novel experimental techniques that enable validation of model predictions at all length scales, we can achieve a true 'Materials by Design' approach for composite materials."

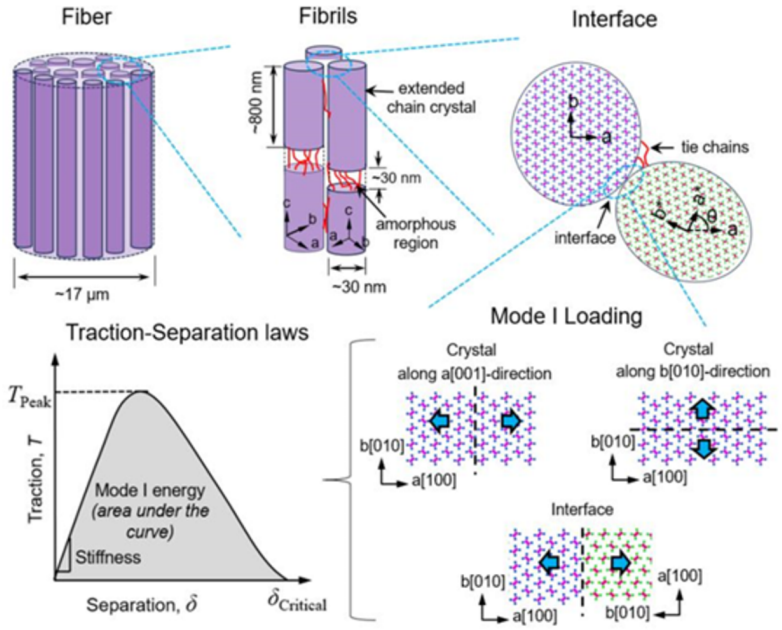


Automated single filament tensile

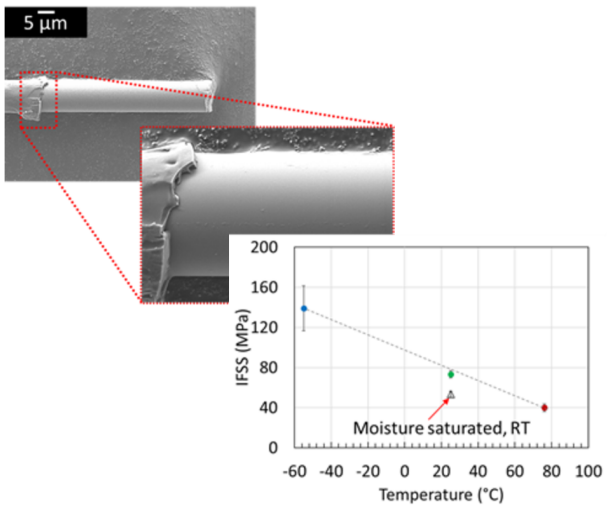


MD simulations of silica-sizing (mono-layer) shows that interphase properties can be improved significantly by increasing GPS bond density with the glass surface

Chowdhury and Gillespie.
Journal of Materials Science 52 (2017): 12981-12998



Molecular dynamics simulations to develop mixed-mode traction laws, which are essential for higher-length-scale finite element models to accurately predict the behavior of UHMWPE fibers under multiaxial loading conditions. Dewapriya, Deitzel, and Gillespie



Effect of temperature and moisture on interface properties

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