

HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM

RESEARCH PROJECT #: HPCMP-FIX-24-026-F

From Molecular Dynamics to Electro-fluid Mechanics: Simulation of Electrowetting for the Next Generation of Space and Aerospace Composites Processing

About AFRL:

Air Force Research Laboratory (AFRL) is a scientific research organization operated by the United States Air Force Materiel Command. AFRL is dedicated to leading the discovery, development, and integration of aerospace warfighting technologies, planning, and executing the Air Force science and technology program, and providing warfighting capabilities to United States air, space, and cyberspace forces.

The Air Force Research Laboratory Materials and Manufacturing Directorate uses a combination of novel and high-impact experiments, in-house high-fidelity HPC simulation software, and machine learning to characterize and predict the performance of current and emerging materials.

RESEARCH LOCATION: Wright-Patterson AFB, OH

PROJECT DESCRIPTION:

Under the guidance of a mentors, the faculty member will collaborate with a team in advance electrowetting-enhanced infusion processes by molecular dynamics (MD) modeling (using LAMMPS) of resin responses in ambient electric fields, including polarization, rheological behavior, and surface tension. The insights gained from MD will inform the material responses utilized in electrohydrodynamic (EHD) simulations for resin infusion into fiber reinforcements. Key inquiries include: 1) determining optimal voltage properties (e.g., magnitude, AC vs. DC, frequency) for infusion quality and mitigating voids, 2) exploring the resin chemistry's influence on electrowetting effects, and 3) assessing the potential of utilizing the fringing electric field of a partially filled capacitor to drive flow into intricate geometrical features. The faculty will gain knowledge and new techniques to share with students in the classroom.

ANTICIPATED START DATE:

May 2024 – Exact start dates will be determined at the time of selection and in coordination with the selected candidate.

QUALIFICATIONS:

The ideal candidate must be full-time faculty from an accredited U.S. pre-college, college, or university with a background in Mechanical Engineering, Chemical Engineering, Physics, or Chemistry. Knowledge of either 1) computational fluid dynamics or 2) molecular dynamics. Knowledge and coursework in electromagnetism are a plus (but not required). Some knowledge of programming such as MATLAB, Python, C++, and/or Julia is preferred. Adjunct or visiting faculty are ineligible.

ACADEMIC LEVEL:

Degree:

- Doctoral

DISCIPLINE NEEDED:

- Computer, Information, and Data Sciences
- Engineering
- Chemistry and Materials Sciences
- Physics
- Science and Engineering related