

INDUSTRIAL & MANUFACTURING ENGINEERING SEMINAR ANNOUNCEMENT

Fundamental Composite Science Underpinning Scalable Manufacturing

**Umesh N. Marathe, Research Assistant
Oak Ridge National Laboratory (ORNL)
University of Tennessee**

**Monday, Feb. 9
11:00 a.m.
MRB Room 114**



Umesh N. Marathe
Research Assistant
Oak Ridge National Laboratory
University of Tennessee



**FAMU-FSU
College of
Engineering**

**This event
sponsored by
FAMU-FSU Engineering
Department of Industrial & Manufacturing Engineering**

Manufacturing is a critical pillar of U.S. economic competitiveness and national security, and when coupled with composite materials, it enables simultaneous advances in technology development, workforce capability, and industrial scale-up across low (TRL 0-3) to high (TRL 5-6) technology readiness levels. While academic research in composite manufacturing typically emphasizes early-stage discovery, this work presents research thrusts that deliberately transition from fundamental composite science to industry-adopted manufacturing platforms. Two representative research thrusts are highlighted: nanofibril-enabled interfacial modification of continuous fiber composites and silicone-based (polydimethylsiloxane, PDMS) composite systems for domestic oven applications. The nanofibril study establishes mechanistic links between formulation design, deposition behavior on fibers, and composite performance, followed by filament winding, multi-scale characterization, and product-level validation. The PDMS composite thrust addresses scalable chemistry, process design, manufacturing challenges, and failure mitigation from laboratory to pilot scale, culminating in a functional composite oven component. Collectively, this work demonstrates how composite science can be leveraged to build application-agnostic intermediates (research thrust 1) and product-specific (research thrust 2) manufacturing platforms by converging materials science with manufacturing science and by asking the right scale-aware research questions.

Umesh N. Marathe, PhD holds a joint appointment at Oak Ridge National Laboratory (ORNL) and the University of Tennessee–Oak Ridge Innovation Institute (UT-ORII) as research assistant professor based at the University of Tennessee Knoxville. He previously served as a researcher at the Oak Ridge National Laboratory, where he worked at the Manufacturing Demonstration Facility (MDF) within the Sustainable Manufacturing Technologies and Composites Innovation groups, manufacturing science division of ORNL.

Dr. Marathe's research centers on advanced and high-rate composite manufacturing, with emphasis on hybrid and high-performance composites, multifunctional and hierarchical interfaces, and scalable processing routes. His work spans manufacturing technologies including additive-manufacturing-compression molding, extrusion-compression molding, induction-heated molding, wet-laid and air-laid nonwoven fabrication, sheet molding compounds, biomaterials and composite joining. These efforts support applications in automotive systems, building and construction materials, energy-efficient home appliances, and emerging mobility platforms.