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Radiative Thermal Management: from Scalable Manufacturing to Sustainable Energy Applications

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Room 2540 GGB

ME Seminar Link
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Abstract:
As global population and living standards rise, energy demand has reached unprecedented levels, necessitating the development of more efficient energy technologies. Controlling thermal radiation

presents a promising strategy for passive cooling and heating, enabling effective thermal management without external energy input. This approach can significantly reduce building energy consumption, enhance personal thermal comfort, and improve energy resilience during power disruptions. In this talk, I will present my recent research on advancing radiative thermal management through innovative material designs and scalable manufacturing techniques. I will discuss the development of advanced radiative cooling and heating materials and their potential for real-world applications. Specifically, I will highlight: 1) daytime radiative cooling films and coatings for passive building temperature regulation; 2) radiative cooling textiles with integrated sensing functionalities for smart wearable applications; and 3) integration of radiative cooling and heating technologies with thermally regenerative electrochemical cycles for low-grade heat harvesting.

Bio:

Dr. Lili Cai is an Assistant Professor in the Department of Mechanical Science and Engineering at University of Illinois at Urbana-Champaign. She obtained her M.S. and Ph.D. in Mechanical Engineering from Stanford University, and completed her postdoctoral training in the Department of Materials Science and Engineering at Stanford. Dr. Cai's research integrates thermal science, nanotechnology and advanced manufacturing to develop innovative solutions for energy and wearable applications. Her research contributions have been recognized with several awards, including MIT Technology Review's 35 Under 35 list in 2020, the American Chemical Society Petroleum Research Fund (ACS-PRF) Doctoral New Investigator Award in 2022, National Science Foundation (NSF) CAREER Award in 2022, Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers (SME) in 2023, and Office of Naval Research Young Investigator Program Award in 2024.