Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2026 Seminar Series

Revolutionizing Immunotherapy: Bioengineered Immune Organs and Nanoscale Technologies

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The human immune system is a complex and vital defense network, yet its dysfunction underlies many diseases. Developing effective vaccines, immunotherapies, and cell therapies for infections, cancer, inflammation, and age-related conditions requires a deep understanding of how immune cells develop and activate in primary, secondary, and tertiary lymphoid organs. Traditionally limited to in vivo studies and 2D in vitro models, which lack full physiological relevance, research is now advancing with engineered human ex vivo immune organoids. These synthetic tissues mimic the structure and function of natural immune organs, enabling precise control of cellular interactions. My lab focuses on developing such organoids by combining engineered materials with donor-derived immune cells to generate antibody-secreting cells and assess immunogenicity. We are also developing advanced organ-on-a-chip systems with full immunocompetence for use in infection, inflammation, oncology, and drug development, thereby opening new possibilities for groundbreaking therapeutic discoveries. Complementing tissue-scale engineering, I will introduce nanoengineered wire platforms that program naïve T cells without pre-activation through localized delivery of regulatory microRNAs. These nanoscale interfaces rewire T-cell fitness, proliferation, and differentiation, thereby enhancing protective responses and improving the design of adoptive cell therapies. These approaches establish a multi-scale framework for controlling immune cell fate and function. I will conclude by outlining a cohesive, forward-looking vision for Biomedical Engineering, highlighting opportunities for advancing research excellence, educational innovation, and translational impact within a strategic framework.

ABOUT the SPEAKER

Ankur Singh is a Carl Ring Family Professor in the George W. Woodruff School of Mechanical Engineering at Georgia Institute of Technology with a joint appointment in the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech and Emory University. At Georgia Tech, he serves as the Director of the Center for Immunoengineering. He is a Fellow of the American Institute for Medical and Biological Engineering. His laboratory develops immune organoids and enabling technologies to understand healthy and diseased immune cells and translate therapeutics. He has received funding from the National Institutes of Health, the National Science Foundation, Wellcome Leap HOPE, the Department of Defense, the Defense Threat Reduction Agency, the Curci Foundation, and the Lymphoma and Leukemia Society. He has published >80 articles in peer-reviewed journals, including Nature Materials, Nature Nanotechnology, Nature Biomedical Engineering, Nature Immunology, Nature Methods, Nature Communications, Nature Reviews Materials, Nature Protocols, Science Advances, Cell Reports, PNAS, Blood, and Advanced Materials. He has written multiple editorials for Science Translational Medicine. He is a recipient of the NSF CAREER, Society for Biomaterials Mid-Career Award, Society for Biomaterials Young Investigator Award, CMBE Young Innovator Award, CMBE Rising Star Award, 3M Faculty Award, DoD Career Award, Georgia Tech CIOS Teaching Award, Cornell's Teaching Excellence Award, and Cornell's Research Excellence Award. His immune organoids were identified among the Top 100 Discoveries of 2015 by Discover Magazine. He is the Founder and past Chair of the Immune Engineering SIG at the Society for Biomaterials and Controlled Release Society. He currently serves as the Associate Editor for Science Advances, Biomaterials, and Cellular and Molecular Bioengineering. He serves on the Executive Advisory Board of the Advanced NanoBiomed Research journal and on the editorial board of Current Opinion in Biomedical Engineering. He serves on the Scientific Advisory Board of Chan Zuckerberg Initiative, Chicago Biohub.

Monday, March 2 at Noon
1003 Engineering Centers (Tong Auditorium)