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JACOBS SCHOOL OF ENGINEERING
Aiiiso Yufeng Li Family Department of
Chemical and Nano Engineering

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DISTINGUISHED SEMINAR

Wednesday, January 22nd, 2025

11:00 AM - 12:00 PM

Fung Auditorium - PFBH 191

Dr. Ankur Singh

*“Revolutionizing Immunotherapy: Bioengineered Immune Organs and
Nanoscale Technologies”*

Carl Ring Family Professor

George W. Woodruff School of Mechanical Engineering

Wallace H. Coulter Department of Biomedical Engineering at Georgia
Tech and Emory Medicine

Director, Center for Immunoengineering at Georgia Tech
Georgia Institute of Technology



Abstract: The human immune system is a marvel of biological complexity, yet its dysfunction underlies numerous diseases. Designing vaccines, immunomodulatory drugs, and cell therapies against infections, cancer, inflammatory conditions, and age-related disorders requires a detailed understanding of how immune cells form and activate in primary, secondary, and ectopic tertiary immune organs. Traditionally, research on the immune system has been restricted to in vivo approaches, which do not allow for the detailed control of intracellular and extracellular processes, and to 2D in vitro models, which lack physiological relevance. These models are being investigated to understand immune function and dysfunction at the cellular, tissue, and organ levels. In this talk, I will discuss my laboratory's effort in developing synthetic, human ex vivo immune organoids to replicate the structure and function of immune tissues. I will discuss strategies to combine engineered materials and immune cells from individuals to generate antibody-secreting cells in a dish or as organ-on-chip against viral and bacterial infections and describe immunogenicity testing efforts. I will further describe the use of human immune organoids in oncology and drug development space, and subsequently describe the integration of immune organoids with complex mucosal organ-on-chip technologies, with applications in inflammation, infection, and oncology. Complementing this, I will introduce nanoengineered wires functionalized with cationic polymers to program naive T cells without pre-activation, a critical advancement for adoptive T-cell therapies. By delivering single or multiple microRNAs, I will describe how nanowires modulate T-cell fitness, influencing proliferation, phenotypic differentiation, and effector molecule secretion. These programmed T cells exhibit enhanced in vivo protection against intracellular pathogens, with tailored differentiation into T cell subtypes.

Bio: Ankur Singh is a Carl Ring Family Professor in 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. Before Georgia Tech, he was a tenured Associate Professor at Cornell University. 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 Institute of Health, National Science Foundation, Wellcome Leap HOPE, Department of Defense, Defense Threat Reduction Agency, the Curci Foundation, and Lymphoma and Leukemia Society. He has published >70 articles in peer-reviewed journals, including Nature Methods, Nature Materials, Nature Nanotechnology, Nature Immunology, 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. Dr. Singh serves on the Scientific Advisory Board of Chan Zuckerberg Initiative (CZI) Chicago Biohub.

Seminar Host: Zeinab Jahed