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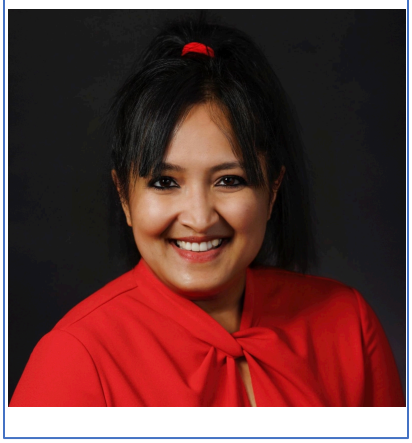
Department of Biomedical Engineering



Riddha Das, Ph.D.
Research Fellow at Massachusetts General Hospital
and Harvard Medical School

Date Friday, October 24, 2025
Time 12:00 to 1:00 PM
Location SEC 203

Title: *Engineering Biomaterials for Cancer Immunotherapy*

Abstract: Antigen-presenting cells (APCs), such as macrophages and dendritic cells (DCs), are key immune response orchestrators and are powerful cellular targets for cancer immunotherapy. Precise spatiotemporal delivery of immune signaling cues is critical for reprogramming these cells to elicit potent anti-tumor immunity. In this talk, I will present how I have leveraged the engineering of nano-, nucleic acid-, and macroscale biomaterials to modulate immune responses and develop next-generation cancer vaccines and immunotherapies. We engineered the surface chemistry of nanoparticles to control the in-situ generation of chemotherapeutic drugs into intra/extracellular space and enable targeted delivery to tissue-homing macrophages. Subsequently, we utilized these design principles to develop a hybrid LNP platform for the co-delivery of TLR-adjuvants and cIAP inhibitors, which induced strong activation of DCs, resulting in complete tumor eradication and long-term immune memory after a single dose in murine models. Simultaneously, ex-vivo-engineered DCs induced robust antigen-specific CD8 T cells, preventing tumor growth in vaccinated mice. To further amplify the ability of these nanoparticle platforms for immunostimulation, we developed mRNA encoding for pleiotropic immune stimulants (mRNA-ADJs) that stimulated innate immune cells as versatile vectors for immunotherapy. These mRNA-ADJs showed high anti-tumor efficacy in multiple tumor models and generated long-term memory response, as evidenced by the absence of tumor growth in rechallenge experiments. Simultaneously, mRNA-ADJs significantly improved Antigen-specific CD8 T cells upon vaccination with tumor neoantigens, sustaining a lasting memory response for up to 3 months and preventing tumor growth in vaccinated mice. These immune stimulants work by (i) enhancing DC activation to prime CD8 T cells, (ii) releasing pro-inflammatory cytokines to attract immune cells and amplify the adaptive response, and (iii) reprogramming immune cells for robust therapeutic effect. In conclusion, I will highlight how these nano-based immunomodulation strategies can complement the macroscale biomaterials such as microneedle patches, electrospun-nanofibers, and hydrogel platforms to develop next-generation smart devices for precise immunoengineering.

Bio: Riddha Das, PhD, is an NIH T32 research fellow at Massachusetts General Hospital and Harvard Medical School. Her research focuses on engineering materials for developing next-generation cancer vaccines and immunotherapies. She received her PhD from the University of Massachusetts Amherst with Professor Vincent M. Rotello, where she worked on utilizing nanomaterials for spatiotemporally controlled bioorthogonal catalysis for imaging and therapy. She has published over 30 scientific papers and is an inventor on 2 granted and pending patents.