ABSTRACT:

Heterogeneously Integrated 2D Optomechanical Resonators on Advanced Photonic Chips for Uncooled Infrared Sensing

Emerging resonant nanoelectromechanical systems (NEMS) enabled by two-dimensional (2D) materials and their heterostructures offer exceptional responsivities and sensitivities for detecting minuscule events and variations in a wide range of applications. A compelling frontier is the heterogeneous integration of such 2D NEMS transducers on modern integrated photonic chips, toward scaling up and enabling novel systems with versatile functions. We analyze and design graphene trampoline 2D NEMS resonators with high opto-thermal-mechanical transduction responsivities, strong thermal isolation, and multiple high-Q nanomechanical resonances that are suitable for low-noise optical transduction and heterogenous integration. We explore optimized designs by analyzing and understanding the multiple engineering tradeoffs involving both properties of the constitutive materials and parameters of geometric design and fabrication processes. In this talk, I will present my collaborative team's research endeavors and results focused on engineering atomically thin nanomechanical resonators, towards pushing the limits in nano-optomechanical resonant sensing and signal transduction. I will report on experimental demonstration and theoretical analysis of harnessing ultrathin 2D trampoline nano-optomechanical resonators with unique potential for uncooled ultrasensitive infrared (IR) detection, and their heterogeneous integration with high-performance photonic crystal cavities on state-of-the-art integrated photonic chips.