Seminar title:

2D Materials and Flexible Electrodes for Sensing Applications

Seminar Abstract:

I will overview our research projects regarding 2D materials, flexible electrodes and their sensing applications. First, I will talk about chemical vapor deposition (CVD)-growth of 2D magnets toward quantum sensing. 2D materials such as graphene, molybdenum disulfide (MoS2), tungsten disulfide (WS2), and hexagonal boron nitride (h-BN) are just a few of a vast family of 2D materials with extraordinary mechanical, optical, electrical, and thermal properties with great promise in enhanced sensitivity to electron interference and ballistic transport. In particular, the ferromagnetism enabled in 2D crystals could lead to discoveries and applications, combined with their already rich electronics and optics. Therefore, heterostructures and devices based on 2D magnets are expected to possess many properties with strong application potential, including electron wave interferometers. However, there are several challenges associated with this approach toward realizing electron interferometers based on 2D materials. To explore the phase-coherent transport governed by the quantum interference effect of electron waves, one must incorporate an on-chip electric/magnetic field to enhance the sensitivity with Sagnac and Rashina effects. 2D magnets will play a significant role here since one can readily incorporate such 2D magnets with graphene ring interferometers. I will talk about the details of this process. If the technique could be developed to be highly reliable and high fidelity, it could have an enormous impact on the future research and commercialization of 2D materials-based sensors. Another research area concerns our development and application of flexible electrodes toward wearable and multifunctional sensors. We develop a facile fabrication technique utilizing vertically aligned carbon nanotubes (VACNTs), enabling high-throughput fabrication of flexible electrodes, demonstrating high flexibility and stability during stretching up to 20% and bending up to 180 degrees while performing sensing function. To this end, these flexible electrodes are promising for various wearable sensor applications. We also investigated graphene microribbons for applications in infrared detectors. We demonstrate fully-suspended graphene microribbons that are dominated by the photoelectric effect. Building on these previous results from 2D material growth, flexible electrode demonstration and graphene photodetector development, our next step is to combine 2D materials with flexible substrates toward next-generation wearable detectors.