

2D Magnetic TMDs for Spintronics and Quantum Sensing



Prof. Eui-Hyeok Yang
Professor

Stevens Institute of Technology

Abstract: I will present two-dimensional (2D) transition metal dichalcogenides (TMDs) with magnetic doping for 2D spintronic devices. While the lack of bandgap is a serious limitation for graphene use in electronic devices, reports have shown promising prospects of using TMDs in electronics and optoelectronics because of their unique properties, complementing graphene. In particular, 2D atomic crystals exhibiting magnetic properties provide an ideal platform for exploring new physical phenomena in the 2D limit, representing a substantial shift in the ability to control and investigate nanoscale phases. Our work demonstrates a 2D dilute magnetic semiconductor at room temperature via an in situ synthesis and characterization of Fe-doped TMD monolayers. We simultaneously achieve the substitutional doping of Fe and the growth of MoS₂ and WS₂ monolayers. We show that Fe incorporates substitutionally into Mo and W lattice sites and probes ferromagnetism in Fe:MoS₂ at room temperature. This new class of van der Waals ferromagnets finds critical applications, including on-chip magnetic field sources, spintronic memories, spin photovoltaics and spin thermoelectric. I will discuss the synthesis, doping, and ferromagnetism of 2D TMDs for 2D spintronic devices.

Dr. E. H. Yang is a Professor of the Mechanical Engineering Department at Stevens Institute of Technology. He began his tenure as a Senior Member of the Engineering Staff at NASA's Jet Propulsion Laboratory and led several projects funded by NASA, DARPA, and NRO. At JPL, he managed and monitored several NASA SBIR projects and participated in the review committee for developing NASA's Multi-Object Spectrometer for James Webb Space Telescope. Dr. Yang joined Stevens in 2006, securing over forty federal grants and contracts totaling approximately \$10M, including NSF, AFOSR, NRO, and US Army funding. He is an AE/EB of Scientific Reports, Micromachines, and IEEE Sensors Journal. Dr. Yang has published over three hundred journal and conference papers and has been invited to give over a hundred keynote/invited talks at conferences, workshops, and university seminars. He was a featured Track Plenary Speaker at ASME IMECE in 2018. He was awarded, among other honors, the Lew Allen Award for Excellence at JPL in 2003, the Award for Research Excellence at Stevens in 2019 and the IEEE Technical Achievement Award (Advanced Career) from the IEEE Sensors Council in 2020. He is IEEE Sensors Council Distinguished Lecturer (2023-2025) and IEEE NTC Chapter Chair (North Jersey Section). Dr. Yang is a Fellow of the National Academy of Inventors. He is also a Fellow of the American Society of Mechanical Engineers.