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*Eui-Hyeok Yang*

Stevens Institute of Technology, USA

Synthesis of 2D flatlands beyond graphene

I will present one of our primary research topics, focusing on our development of the chemical vapor deposition (CVD)-growth of 2D materials; we develop a direct growth process to enable localized, patterned, single crystalline or large-scale polycrystalline monolayers of TMDs, including MoS₂, WS₂, WSe₂ and MoSe₂, along with their heterostructures. TMDs are emerging graphene analogues with unique properties for optoelectronic applications, but they are prone to rapid oxidation in air, presenting a critical roadblock in practical device applications. In attempts to overcome this issue of TMD oxidation, we study CVD-growth and perform extensive material characterization to illuminate the role of dissimilar 2D substrates in the prevention of interior defects in TMDs, thus uncovering the conditions for anti-oxidation. This research provides a detailed look into the oxidation and anti-oxidation behaviors of TMDs, which corroborates the role of underlying 2D layers in the prevention of interior defects in TMDs. We furthermore show the epitaxial growth of TMDs on hBN and graphene, as well as vertical/lateral heterostructures of TMDs, uniquely forming in-phase 2D heterostructures, and we examine the resulting quality and integrity of differing heterostructure. If the technique could be developed to be highly reliable and high fidelity, it could have a high impact on the future research and commercializability of TMD-based devices.

Biography

Dr. E. H. Yang is a full professor of Mechanical Engineering Department at Stevens Institute of Technology. He received Ph.D. degrees from Ajou University, Korea. After his postdoctoral training at University of Tokyo and at California Institute of Technology, he joined NASA's Jet Propulsion Laboratory where he became a Senior Member of the Engineering Staff. At JPL, he received a number of awards, including NASA ICB Space Act Awards, Bonus (Level B and C) Awards and a number of Class 1 NASA Tech Brief Awards. In recognition of his excellence in advancing the use of MEMS-based actuators for NASA's space applications, he received the prestigious Lew Allen Award for Excellence at JPL in 2003. His scholarly leadership has been recognized by peers. Examples of these efforts include being appointed as an Associate Editor and/or Editorial Board of several journals including Nature's Scientific Reports, and being elected as the Division Chair of the ASME MEMS Division. Since joining Stevens in 2006, he has been responsible for obtaining competitive research funding from several federal agencies including NSF, AFOSR, US Army, NRO, NASA and DARPA (including 6 NSF and 3 AFOSR grants, and 5 NASA and 3 NRO contracts). Dr. Yang holds over 12 patents issued or pending. Dr. Yang is the director of the Micro Device Laboratory, a Stevens's multi-user microfabrication facility.

eyang@stevens.edu

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