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Vapor-Phase Infiltration for Energy-Efficient, Extremely Downscaled Semiconductor Devices

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Abstract

Semiconductors are a crucial component of modern electronics, enabling essential functions in society such as communication, computing, healthcare, military systems, transportation, and clean energy, among countless others. However, the ever-increasing demand for high performance and bandwidth in electronics is presenting unprecedented energy efficiency challenges for semiconductor technologies. To address this, we require a fundamental paradigm shift in electronics architecture as well as extreme downscaling of semiconductor devices beyond Moore's law. During this talk, I will showcase our recent efforts to address these challenges using a novel technique called vapor-phase infiltration (VPI), an organic-inorganic hybridization method based on atomic layer deposition (ALD). Specifically, I will discuss how VPI is being used to develop new hybrid materials in two specific areas: (a) advanced photoresists required for extreme ultraviolet (EUV) lithography, which is crucial for sub-3 nm node semiconductor chips, and (b) brain-inspired neuromorphic memory devices. If time permits, I will also briefly explain a novel patterning technique enabled by the application of VPI in self-assembled block copolymers (BCPs).

Biography

Dr. Chang-Yong Nam is a Scientist at the Center for Functional Nanomaterials (CFN) of Brookhaven National Laboratory (BNL), and an Adjunct Professor of Materials Science and Chemical Engineering at Stony Brook University. Dr. Nam received his Ph.D. in Materials Science and Engineering from the University of Pennsylvania (2007), M.S. in Materials Science and Engineering from KAIST (2001). and B.E. in Metallurgical Engineering from Korea University (1999). Dr. Nam's research is focused on two primary areas: (a) Development of ALD methods towards microelectronics and energy applications; (b) Materials processing and device physics in low-dimensional semiconductors. His awards include Battelle Inventor of the Year (2022), Winner of DOE National Labs Accelerator Pitch Event (2021), BNL Spotlight Awards (2022, 2018, 2011), and Goldhaber Distinguished Fellowship (2007).

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