NS-004 **<Invited Speaker>**

Si-Containing Nanostructures for Energy-Storage, Sub-10 nm Lithography, and Nonvolatile Memory Applications

정연식

KAIST 신소재공학과

This talk will begin with the demonstration of facile synthesis of silicon nanostructures using the magnesiothermic reduction on silica nanostructures prepared via self-assembly, which will be followed by the characterization results of their performance for energy storage. This talk will also report the fabrication and characterization of highly porous, stretchable, and conductive polymer nanocomposites embedded with carbon nanotubes (CNTs) for application in flexible lithium-ion batteries. It will be presented that the porous CNT-embedded PDMS nanocomposites are capable of good electrochemical performance with mechanical flexibility, suggesting these nanocomposites could be outstanding anode candidates for use in flexible lithium-ion batteries.

Directed self-assembly (DSA) of block copolymers (BCPs) can generate uniform and periodic patterns within guiding templates, and has been one of the promising nanofabrication methodologies for resolving the resolution limit of optical lithography. BCP self-assembly processing is scalable and of low cost, and is well-suited for integration with existing semiconductor manufacturing techniques. This talk will introduce recent research results (of my research group) on the self-assembly of Si-containing block copolymers for the achievement of sub-10 nm resolution, fast pattern generation, transfer-printing capability onto nonplanar substrates, and device applications for nonvolatile memories. An extraordinarily facile nanofabrication approach that enables sub-10 nm resolutions through the synergic combination of nanotransfer printing (nTP) and DSA of block copolymers is also introduced. This simple printing method can be applied on oxides, metals, polymers, and non-planar substrates without pretreatments. This talk will also report the direct formation of ordered memristor nanostructures on metal and graphene electrodes by the self-assembly of Si-containing BCPs. This approach offers a practical pathway to fabricate high-density resistive memory devices without using high-cost lithography and pattern-transfer processes. Finally, this talk will present a novel approach that can relieve the power consumption issue of phase-change memories by incorporating a thin SiO_x layer formed by BCP self-assembly,

which locally blocks the contact between a heater electrode and a phase-change material and reduces the phase-change volume. The writing current decreases by 5 times (corresponding to a power reduction of 1/20) as the occupying area fraction of SiO_x nanostructures varies.

Keywords: block copolymer, lithium ion battery, resistive memory, phase-change memory