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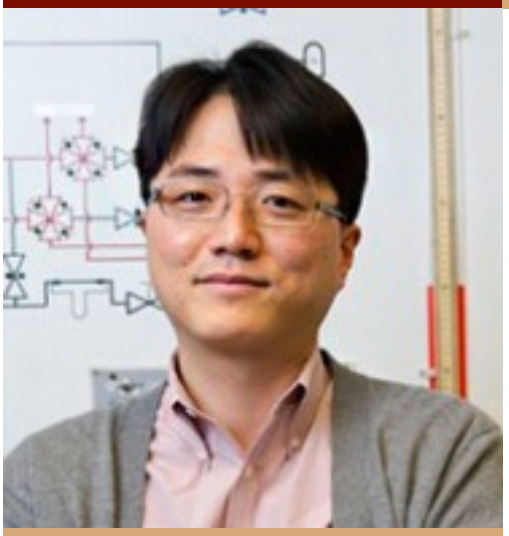
Engineering Carbon Nanostructured Architectures



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Abstract: Over the past decade, researches on sp^2 nanostructured carbon materials (CNT, graphene, nanostructured graphite) designed for a range of micro- and macroscopic functional devices and systems have made remarkable progress. However the scalable fabrications of tightly controlled and multicomponent systems that harness 2-3 dimensional and multiscale architectures of organized carbon nanostructured materials have remained largely elusive. Such methodologies will allow multifunctional and high performance devices and systems in broad ranges of applications such as chemical-biological sensors, flexible electronics, energy storage devices etc.

Here we present some of our recent progresses in building highly organized and controlled carbon nanomaterials based 2-3D architectures and their hybrid systems by combining state-of-the art synthesis, assembly and transfer based nanomanufacturing strategy developed in our laboratory. For examples, unique suspended singlewalled carbon nanotube (SWCNT) micro architectures built on micro patterned polymer substrates are achieved through unprecedented control over fluidic assembly and wet contact printing transfer processes for various flexible and transparent MEMS devices. We also demonstrate precisely-controlled allotropic transformations and formation of their molecular junctions using controlled alternating voltage pulses. Small-diameter single-walled carbon nanotubes (SWCNTs) can be selectively transformed into (1) larger diameter SWCNTs, (2) multi-walled carbon nanotubes, (3) multi-layered graphene nanoribbons, and (4) structures with sp^3-bonds with remarkable reproducibility. Finally a generic synthetic approach to rationally design extremely short tubular carbon nanostructure, called carbon nanocup, inside anodic aluminum oxide templates will be presented. Using extremely short nanochannels, 3D architectures engineered from graphitic carbon, revealing unique morphologies of nanoscale cups and large area connected nanocup film were fabricated. The nanocups are highly effective to contain other nanomaterials and polymers enabling multi-component functional carbon nanostructured systems for various applications from nanometrology to energy storage devices.

Biography: Dr. Yung Joon Jung is an Associate Professor of Mechanical Engineering who received his Ph.D. in Materials Science and Engineering from Rensselaer Polytechnic Institute in 2003. In 2002, he worked as a visiting researcher at NTT Basic Research Laboratories (Device Physics) in Japan. From 2003 to 2005 he worked as a Postdoctoral Fellow at Rensselaer, and joined Northeastern University as an Assistant Professor in September 2005, working in the Department of Mechanical and Industrial Engineering. The research of Jung's research lab focuses on investigating new synthetic routes for low dimensional nanomaterials and engineering their molecular structures. His group also develops nanomanufacturing processes such as assembly, transfer and integration of nanomaterials and nanostructured architectures for nanoelectronics, flexible devices, chemical sensors and energy storage applications supported by NSF, DoD, and industries. He published over 5o articles in high impact journals and book chapters such as Nature, JACS, Nano Letters, ACS Nano, Nature Scientific Reports etc.