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Hierarchical Hybrid Architectures for Robust and Reusable Nano-devices

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Nanomaterials are known to offer significant advantages in a wide variety of applications. However, their use in engineering devices is often limited by challenges of handling and storage combined with environmental proliferation risks. We have addressed this dilemma by creating hierarchical hybrid materials comprising of tailored arrays of nanotubes and nanoparticles that remain strongly adhered to larger substrates. This presentation will focus on some of these novel architectures investigated in this laboratory, which are inspired by biological surfaces such as microvilli and capillaries. Natural biomaterials often have a large unifying scaffold that supports progressively smaller and more specialized attachments to provide extremely high interaction area in very compact space. Such architectures are rarely used in engineered materials due to the complexities of bonding components of different sizes, shapes and compositions into one solid. However, as will be presented, recent advances in nanoscale processing have made it possible for us to fabricate these types of solids, which provide very significant advantages over conventional materials. We will focus on one family of multiscale nanocarpet-based solids that has demonstrated significant promise in a wide variety of applications. Examples include unusual toughening in composites, high charge storage density in capacitors, high thermal dissipation in power electronics, filters and agitators for water disinfection and pollutant degradation, hand-held pathogen sensors and tissue-engineering scaffolds. These results underscore the versatility of hierarchical hybrid nanomaterial design that can utilize the synergy between nanoscale surface features and macroscale substrates to provide functional (chemical, catalytic, thermal, electrical, magnetic, structural or responsive) advantages at different levels.

Biography

Sharmila M Mukhopadhyay is a Professor and Founding Director of Center for Nanoscale Multifunctional Materials at Wright State University, USA. She had pursued her BSc at Indian Institute of Technology and PhD from Cornell University. She had served as Jefferson Science Fellow and Scientific Advisor to US Department of State and was elected as a Fellow of The American Ceramic Society. She has around 100 publications and received research awards from major scientific sponsors such as NSF, DOE, AFOSR, AFRL, NASA, EPA and OBOR, etc. Her work has been featured on multiple scientific media releases such as *AzoNano, PhysOrg*, *Ceramic Bulletin* and *BizJournal*.

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