Functional Nanomaterials Fabricated by Dynamic Shadowing Growth

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Dynamic shadowing growth (DSG) is a simple nanofabrication technique based on physical vapor deposition with substrate manipulation and deposition source control. The geometric shadowing effect is the dominant growth mechanism. By programming the substrate rotation in the polar and/or azimuthal direction, nanorod arrays with different geometric shapes can be designed. In addition, by combining this directed substrate motion with a programmed deposition procedure, such as multilayer deposition or co-deposition, one can design complex and multifunctional heterogeneous or composite nanostructures. Based on the material and morphology, applications of nanorods designed by DSG have been extended to many different areas, from fundamental understanding of wetting phenomena to biomedical applications. In this talk, I will first discuss our recent efforts in designing functional materials by DSG, especially heteronanorod and composite nanostructure fabrications. Then I will highlight two applications: the development of optical chiral metamaterials and the utilization of active nanomotors. By combining two-dimensional colloid monolayers and DSG, we have recently demonstrated that various chiral plasmonic nanostructures can be fabricated with tunable response in visible to near-infrared wavelengths. By asymmetrically coating nanorod backbones with thin catalyst layers, self-propelled, autonomously moving nanomotors and motor systems can be assembled, mimicking naturally occurring biological motors. Finally, we have demonstrated that by incorporating active nanomotors into thrombolytic therapy for stroke, the effectiveness of the drug can be doubled due to the enhanced mass transport, which could significantly lower the dose of the drug administrated and reduce the risk of the intracranial hemorrhages.

Bio: Dr. Yiping Zhao received his B.S. degree in Electronics from Peking University in 1991, and MS degree in condensed matter physics from Institute of Semiconductors, Chinese Academy of Sciences in 1994. He completed his Ph.D. degree in Physics at Rensselaer Polytechnic Institute in 1999. He is currently a Professor at the Department of Physics and Astronomy in University of Georgia. Prof. Zhao is the author or co-author of more than 200 peer reviewed journal papers, 2 books, 5 book chapters, and 9 US patents. He has received the 2009 UGA Creative Research Medal. His major research interests are nanostructures and thin films fabrication and characterization, plasmonic nanostructures, chemical and biological sensors, nano-photocatalysts, and nanomotors.