A Facile Biomimetic and Bioinspired Strategy for synthesis of Advanced Multi-component Heterostructures

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Abstract
In this presentation I will highlight our pioneering work on the directed self-assembling of biomimetic protein polymers as the directing and stabilizing agent for synthesis of conducting carbon based heterostructure (graphene, carbon nanotube, carbon blacks, etc.) of supported metal nano-particles (NP) and nano-clusters (NC)/quantum dots of controlled size and unique characteristics. Emphasis will be given on resilin-mimetic protein-polymers (RMPs); and discuss their unique molecular architecture, advanced multi-stimuli responsiveness (1-5); and their guided self-assembling as a directing agent [5-9]. The approach has revealed for the first time the potential of the RMPs to pave the way for the design of novel heterostructure of nano-bio conjugates and quantum dots for nanotechnology, nano-biotechnology, medicine and tissue engineering (6-9). Particular focus of the presentation will be on the carbon – (including carbon, carbon nanotubes and reduced graphene oxide-RGO) supported Pt-nanoparticles (PtNPs) that has demonstrated significant promise as electrocatalyst for oxygen reduction reaction (ORR) in H_2/O_2 fuels cell (8). RGO supported PtNPs shown relatively higher stability than amorphous carbons.
Native Resilin is a member of the family of elastic proteins that includes elastin, gluten, gliadin, and spider silks and is purported to be the most resilient elastic material known with resilience >97% (1). The emergence of recombinant DNA technology has enabled us to synthesize resilin-mimetic protein polymers of controlled molecular architecture. I will discuss the general protocol used to utilize rec1-resilin as a nano reactor for the synthesis of controlled small particles. Various state-of-the-art characterization techniques including, SAXS, SANS, TEM, and electrochemical methods have been employed for in-depth understanding of the synthetic process and the resulting heterostructures. The NC building blocks so synthesized have been integrated into electrodes and the outstanding performance of the PtNCs as electrode materials has been demonstrated using a fuel cell.

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