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Directional Templating of Anisotropic Nanoparticles using Poly (pyromelliticdianhydride-p-phenylene diamine)

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Research into anisotropic nanomaterials has significantly increased due to their potential applications in cancer cell imaging, surface enhanced Raman scattering, sensors, optical contrast agent, photochemical cancer therapy among other applications. Anisotropic nanomaterials are a class of materials whose structures, properties, and functions are direction-dependent. This presentation will focus on the use of poly (pyromelliticdianhydride-p-phenylene diamine) (PPDD) as a reducing & stabilizing agent, immobilization matrix, and directional template for the synthesis of anisotropic silver nanoparticles (AgNPs). It will also discuss a new physical insight into the mechanisms of directional templating of anisotropic nanoparticles based on diffusion limited aggregate model and coalescence growth mechanism. Molecular dynamics (MD) simulations and density functional theory (DFT) calculations were performed to provide insight into possible conformation of PPDD monomer. Anisotropic (non-spherical) peanut-shaped, nanorods and dendritic nanostructures were prepared in situ using varying concentrations of precursors from 0.1% w/v to 1.0 % w/v within PPDD matrix. The PPDD served as the reducing and directional template, thus enforcing preferential orientation. The mechanism of formation and growth of the polymer-mediated anisotropic nanoparticles was confirmed using transmission electron microscopy (TEM), UV-vis near-infrared absorption spectra (UV-vis-NIR), and X-ray diffraction (XRD).