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Electrophoretic Deposition of Thin Films of Nanoparticles

JAMES DICKERSON, Vanderbilt University

Nanoparticles have attracted considerable interest recently due to their size-dependent, quantum confinement characteristics, which make them attractive for an array of optical, magnetic, and electronic devices. For nanoparticles to be employed in an array of commercial and industrial applications, a technique for the facile, site-selective assembly of homogeneous, densely packed, defect-free thin films must be realized. Widely used methods for casting nanoparticle (NP) constituents into films have recognized limitations, including the inability to achieve both large-scale ordering of the nanoparticles and robust chemical and structural properties. NP deposition schemes also require an understanding of both the NP dynamics in suspension and the interactions that govern nanoparticle-substrate and nanoparticle-nanoparticle binding. Although research has been conducted on the assembly of nanoparticles with a distribution of surface charge states, little has been done on the assembly of like-charged nanoparticles. The only NP deposition scheme that considers the physical characteristics of the NPs in the film formation and incorporates the most favorable attributes of NP deposition is electrophoretic deposition (EPD). Recent progress in the NP EPD will be the emphasis of this presentation. Highlighted are the recent discoveries of the size dependence of the thickness of iron oxide NP films and the fabrication of free-standing NP films.