Condensed Matter Seminar

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Methods to improve the optical and mechanical properties of silica nanoparticle ISAM films on glass and polycarbonate substrates

Abstract:

The incorporation of silica nanoparticles in ISAM (ionic self-assembled multilayer) deposition produces a film with high uniformity and optical quality. This is because the nanoparticles conform into a random close-packed (RCP) structure, and create a nanoporous 3-D network with a macroscopic refractive index that closely satisfies one of the key requirements for minimal reflectance of light from the film and substrate. A critical drawback of the nanoporous film however, is a limitation on the electrostatic interactions between the nanoparticles and the polycation that 'glues' them together. Consequently these optically superior films suffer from a lack of cohesion, as well as adhesion to the glass substrate. In this presentation we will look at novel methods we have explored in order to improve the mechanical stability of silica nanoparticle films. These methods range from utilization of unique chemistries to initiate cross-linking, to thermal nanoparticle fusion. Furthermore we briefly address the possibility of constructing broadband anti-reflection coatings by depositing alternating dielectric stacks of high and low refractive index. Finally we address the critical challenges of depositing silica nanoparticle films onto thermoplastics with high impact resistance; in this case polycarbonate. We show by utilizing deep UV irradiation that we can alter the molecular structure of polycarbonate, and populate the surface with functional species to permit uniform ISAM deposition.

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