

Department of Chemical and Biomolecular Engineering

Graduate Seminar Series

Nanocomposites with Grafted Nanoparticles

Tuesday, September 29, 2015, 3:30 pm

141 DeBartolo Hall

A central area of research in the soft matter community is inorganic/organic hybrid materials with nanoscale inorganic particles. These materials have been focused on due to their promise of having synergistic thermal, mechanical and optical properties relative to the pure materials. It is now accepted that the spatial distribution of the inorganic nanoparticles critically affects the properties of the resulting materials; the grand challenge is to control the spatial distribution of the inorganic, hydrophilic nanoparticles in the organic, hydrophobic polymer matrix. I focus on one particular approach to controlling nanoparticle spatial dispersion, the use of polymer-grafted nanoparticles (NP). In the case where the NP and the grafted polymer chains energetically "dislike" each other, we have an architecture akin to a microphase separated block copolymer or a surfactant. Analogous to surfactants, these grafted nanoparticles also assemble into a range of morphologies, thus giving us the unprecedented ability to control the particle dispersion state.

The talk first focuses on the factors controlling this assembly and use this knowledge to consider the utility of other approaches to self-assembly – we show that the use of crystallizable polymers allows us to control nanoparticle order, in particular by varying the rate at which these materials crystallize. This allows us to mimic the growth of organisms such as nacre and oysters, whose shells combine the dual advantages of high strength and toughness. In a different vein, these grafted nanoparticles show the ability to creating membranes that have the potential to revolutionize the separation of hydrocarbons and in carbon sequestration.

Sanat K. Kumar is Professor and Department Chair of Columbia University's Department of Chemical Engineering. His research interests include: biochemical engineering, composite materials, interfacial phenomena, nanotechnology, and polymers.



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