Thermally Conductive Composites and Smart Coatings

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Due to miniaturization of electronics, including smart phones, computers, LED Lighting, there is lot of heat that gets generated inside the parts and need to be dissipated. Polymers have very low thermal conductive up to 0.25 W/MK and these applications require thermally conductive and electrically insulative parts with thermal conductivity up to 7-10 W/MK. This work will focus on developing thermally conductive and electrically insulative composite materials using surface modification of fillers and understanding composites structure property relationship with polymeric matrix along with thermal conductivity of composite material.

Second part of the presentation will focus on development of ultra-low surface friction polymeric films from aqueous colloidal dispersions containing fluorinated and non-fluorinated polymers for smart coatings applications. Since fluoropolymers (FP) exhibit very low solubility in most of the organic solvents and fluorinated solvents as well as extreme processing conditions restrict their applications. This study demonstrates for the first time, that the use of bioactive dispersing agents facilitates polymerization of n-butyl acrylate (nBA), methyl methacrylate (MMA), and fluoro-monomers (FM) under emulsion polymerization system. This approach allowed us to create colloidal dispersions consisting of FP that exhibit unique non-spherical particle morphologies. Such particles upon coalescence form phase-separated films in which FP migrates to the film-air interphase creating ultra low surface energy and friction. Second part of the presentation will focus on the FP containing styrene system which includes synthesis of heterogeneous particles of acorn shaped - containing phases of fluorinated and non-fluorinated segments. These colloidal particles are capable of self-assembling on surfaces, and depending on the surface energy of the substrate, create switchable hydrophobic or hydrophilic surfaces. Orientation of the acorn nanoparticles is driven by the surface energy of substrate, such that for high surface energy substrate p-PFS phase is expressed at the surface, whereas for low surface energy substrates hydrogenated phase is near the film-air (F-A) interface.