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Processes for Dispersing Single Wall Carbon Nanotubes in Polymers and How to Determine Their Spatial and Alignment Distributions.

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We are currently designing and making polymer nanocomposites with single wall carbon nanotubes (SWNT) to obtain improved mechanical properties, electrical conductivity, flammability, and thermal conductivity. Our coagulation method is broadly applicable to nanocomposites using readily-soluble thermoplastics such as polystyrene and poly (methyl methacrylate). A variation of this method has been developed for nanotube/polymer composites based on high-density polyethylene. Nylon-based composites are prepared using our adaptation of an *in situ* interfacial polymerization method. Epoxy-based SWNT composites are prepared using either shear mixing with multi-step thermal treatments or an infiltration method using a freestanding SWNT network. Recent studies have explored the use of solid-state shear pulverization to disperse SWNT. Rheology is employed to evaluate the spatial distribution of SWNT based on the onset of solid-like behavior associated with the formation of a SWNT network. Morphological tools including various microscopy methods, x-ray scattering and Raman imaging, are used to evaluate both dispersion and alignment. The resulting spatial and alignment distributions of SWNT depend on the composite fabrication method and any subsequent processing, such as melt fiber spinning to effectively align SWNT. Examples will be given detailing the importance of (1) SWNT dispersion on flammability and thermal conductivity and (2) SWNT alignment on electrical conductivity.