Thermodynamically Stable, Optimally Tuned Pure Organic Solvent Blends Enable Enhanced Thermoplastic and Thermoset Nanocomposites

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Fundamental discoveries and patents from our labs have enabled creation of exfoliated, stable nanoparticle solutions that can be used to create composites and coatings with enhanced performance characteristics. In 2008 we published (Adv. Mat. 20(10), 1876, 2008) evidence that carbon nanotubes are actually thermodynamically soluble and in chemical equilibrium with NMP as a solvent. We extended the work into other nanomaterials in 2010 and later.

Further progress was made after specialty instrumentation including Low Detection Limit Static Light Scattering, high accuracy Surface Tensiometers and multichannel Sedimentation devices were designed and constructed. Data from these instruments led to the discovery of sharp resonances in experimental solvent/solute surface energy that enables determination of optimum solvent/solute interaction energies (solubility) and now, a general process for nanoparticle solubility in pure organic solvent blends. These optimally tuned solvent blends have demonstrated ten fold enhanced nanotube solubility from our original discoveries, and further, an extension of these principles to all nanoparticles, including graphene, nanocellulose, metal oxides and metal chalcogenides.

We have strength and property test of some nanocomposite thermoplastics and thermosets that may be part of the future of composite materials. Recent results with AFM, Raman Mapping and mechanical thermal and electrical Characterization nanocomposites will be presented.

1. "Towards solutions of SWNT's in common solvents," ADV. MATERIALS, 20(10), 1876, 2008
2. "Multicomponent Solubility Parameters for SWNT-Solvent Mixtures," ACS NANO, 3(8), 2340-2350, 2009
3. "New Solvents for Nanotubes: Approaching the Dispersibility of Surfactants," J.PCHEM, 114(1), 231-237, 2010