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Nanoscale Optimization of Ultrasonic Dispersion of Multi-Walled Carbon Nanotubes in Polyelectrolyte Aqueous Solution

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Extended Abstract:

As structural engineers use next-generation materials that have complex aging and damage modes and legacy structures that are nearing their service lives, in situ monitoring of these structures' health is necessary to keep the public safe from potential structural failures. One of the thrust areas in structural health monitoring is using electrically-based methods for damage detection and structural deterioration. These methods detect for changes in electrical conductivity which have been correlated to certain damage modes. In order to apply this sensing methodology to large-scale structures, the structure must have appropriate electrical properties, or a conductive material is applied to the surface. One main thrust area of electrical sensing is applying carbon nanotube thin films to structures. For large scale deposition, we have developed a latex-based carbon nanotube (CNT)-poly(vinylidene fluoride) (PVDF) thin film that is able to be spray-deposited for large areal deposition. It is widely known that the amplitude of electrical conductivity of these nanocomposites is directly linked to the CNT weight ratio in the film and the quality of the dispersion. Using ultrasonic energy to separate the CNTs has been shown to de-agglomerate the CNTs but can cleave them into shorter CNTs. This study reports the optimization of ultrasonication time and amplitude of multi-walled carbon nanotubes dispersed and polymer-wrapped into a poly(sodium 4-styrenesulfonate) (PSS) solution. The resulting CNTs are analyzed for length and agglomeration under AFM as well as for conductivity of the resulting CNT-PVDF thin film.

Short Abstract:

It is widely known that the amplitude of electrical conductivity of CNT nanocomposite thin films is directly linked to the CNT weight ratio in the film and the quality of the dispersion. Using ultrasonic energy to separate the CNTs has been shown to de-agglomerate the CNTs but can cleave them into shorter CNTs that decreases their advantageous high aspect ratios. This study reports the optimization of ultrasonication time and amplitude of multi-walled carbon nanotubes dispersed and polymer-wrapped into a poly(sodium 4-styrenesulfonate) (PSS) solution. The resulting CNTs are analyzed for length and agglomeration under AFM as well as for conductivity of the resulting CNT-PVDF thin film.