Interfacial Engineering for Polymer Nanocomposites with Tailored Properties

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Objective:
Develop poly(ethylene-co-acrylic acid) (PEcoPAA) nano-hybrid “shish kebabs” (NHSKs) for improved dispersion, wetting and interfacial interactions in carbon nanotube polymeric composites.

Approach:
Synthesize PEcoPAA NHSKs via a solution crystallization technique. Vacuum deposit buckypaper-like NHSK films with enhanced wetting behavior and porosity. Develop unique polymer nano-composites by infiltrating the NHSK films with shape-memory epoxy. Characterize composite structure, morphology, thermal behavior, mechanical properties and electrical properties.

Impact:

Poly(ethylene-co-acrylic acid) NHSKs: Decorating CNTs with PEcoPAA single crystals is a controlled and robust method to non-covalently functionalize a CNTs surface with carboxylic acid groups. Non-covalent functionalization preserves the sp² CNT hybridization, thus maintaining the CNT intrinsic properties. Applications in sensors, filtration, catalyst supports and composites are expected.

NHSK Composites: Epoxy infiltration creates a unique material with high mechanical properties (21 GPa Young’s Modulus, a 1400 % increase of neat Epoxy), enhanced electrical conductivity (3 S/m), and reversible shape memory behavior at 75oC (corresponding to Epoxy Tg). Applications anticipated in self-healing coatings, sensors, actuators and smart structural repair.

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