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Adaptive and Responsive Polymer NanoComposites

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In addition to thermal-mechanical improvements of commodity plastics, polymer nanocomposite concepts offer opportunities to impart *responsive* characteristics as well as enhance the performance of *active* polymers, including shape memory and piezo - resistivity. Opportunities arise from 1) the utilization of the extensive polymer-nanoparticle interfacial area (>500 m^2/g), 2) the responsiveness of the percolative network of the nanoparticle to external fields, and 3) the impact of nanoscale compositional fluctuations on the local electric field. As an example, carbon nanotube addition to shape memory polymers increases blocking stress by 100% and provides novel electrical and optical methods to trigger recovery. Similarly, the pyro-resitive character of carbon nanotube – polyimide nanocomposites depends on the surface modification of the nanotube, displaying a positive coefficient of resistivity (resistance increase with temperature) from cryogenic to the glass transition temperature. Challenges facing characterization and the establishment of structure-property correlations will be discussed.