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APPLICATIONS OF COLLOIDAL NANOCOMPOSITES IN PRESSURE-SENSITIVE ADHESIVES

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An effective, yet simple, method for creating nanocomposite coatings, fibres, and adhesives is to blend an aqueous suspension of carbon nanotubes (CNTs) with waterborne polymer colloids. The nanocomposite films are found to conduct electricity and to retain optical clarity while having an elastic modulus and toughness that are greater than found in the polymer alone.

In processing these nanocomposites, there is a wide choice of surfactants and water-soluble polymers to disperse the CNTs in water. We have found that the dispersant can influence the stress transfer between the nanotube and the matrix, which is essential for achieving high stiffness, while still allowing interfacial slippage to increase energy dissipation. Thus, through careful selection of the dispersant, the mechanical properties of the nanocomposite can be optimised for application as a pressure-sensitive adhesive.

From measurements of the tensile deformation of the nanocomposites, the interfacial shear strength, τ, between the nanotube and matrix was determined as a function of the interfacial polymer chain length and its interfacial density, Σ. The results show that τ increases with increasing Σ and then levels off above a critical value. The value of τ (per chain) increases with the chain length. This result can be explained by an increase in molecular friction during chain pull-out from the matrix with increasing chain length and density, as expected from the theory of brushes at interfaces with rubbers. Our findings can be used to guide the interfacial design of soft nanocomposites.