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Nanomechanical characterization of carbon nanotube-polymer interfacial strength

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ABSTRACT

The interfacial stress transfer between carbon nanotubes (CNTs) and polymer matrices plays a critical role in the mechanical performance of CNT-reinforced polymer nanocomposites. In this discussion, we present an experimental study of the mechanical strength of the interfaces formed by individual CNTs with poly(methyl methacrylate) (PMMA) and epoxy resin, respectively. The nanotube-polymer interfacial strength is characterized using an in-situ electron microscopy nanomechanical single-tube pull-out techniques. By pulling out individual tubes from polymer matrices using atomic force microscopic force sensors inside a high resolution electron microscope, both the pull-out force and the embedded tube length are measured with resolutions of a few nano-Newtons and nanometers, respectively. The measurements reveal the shear-lag effects on both CNT–PMMA and CNT–epoxy interfaces. The results show that the maximum pull-out load of CNT-epoxy interfaces is ~40% higher than that of CNT–PMMA interfaces. This study contributes to a better understanding of the interfacial stress transfer in nanofiber-reinforced polymer nanocomposites.