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**Synergistic interfacial reinforcement of carbon fiber/polyamide 6 composites using carbon-nanotube-modified silane coating on ZnO-nanorod-grown carbon fiber**

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**Abstract**

We report an experimental study on improvement of mechanical properties of a multiscale hybrid composite consisting of *in-situ* polymerized polyamide-6 and zinc oxide nanorod(ZnO NR)-grown woven carbon fiber (WCF) coated with carbon nanotube(CNT)-modified silane. The ZnO growth process and silane coating process were performed on the fiber surface, and then the composite was fabricated by ultra-fast (< 30 s from infusion to polymerization) thermoplastic resin transfer molding technique with extremely low viscosity of resin. The ZnO NRs formed mechanical interlocking with polymer matrix, and at the same time, the CNTs-modified silane layer on WCFs and ZnO NRs formed covalent bond with the matrix; therefore, they induced strong interaction between matrix and fibers, thereby resulting in remarkable improvements in the mechanical properties of the composite. The morphology, coating thickness and composition of the CNTs-modified silane/ZnO/WCF surface according to amount of the silane coupling agent were analyzed and their effects on mechanical

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