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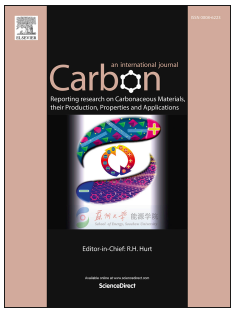

Grafting Carbon Nanotubes Directly onto Carbon Fibers for Superior Mechanical Stability: Towards Next Generation Aerospace Composites and Energy Storage Applications

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Grafting Carbon Nanotubes Directly onto Carbon Fibers for Superior Mechanical Stability: Towards Next Generation Aerospace Composites and Energy Storage Applications

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ABSTRACT. A novel chemical method was developed to graft carbon nanotubes (CNTs) onto carbon fiber (CF) by direct covalent bonding to form a CNT–CF hierarchical reinforcing structure. The grafting via ester linkage (formed at a low temperature of 70^{o}C without using any contaminating catalyst or coupling agent) was evidenced by SEM, FTIR, RAMAN, XPS and XRD spectroscopy. The CNT failure stress obtained from *in situ* SEM pulling out experiments varied from 25 to 31 GPa, depending on the grafting reaction conditions. CNT fracture was the only breaking mechanism observed from the pulling out experiments indicating an existence of a strong carbon-carbon covalent bonding at the CNT–CF interface and the real grafting strength was actually higher than the measured failure stress. This high grafting strength can significantly increase the interfacial and impact properties desirable in next generation advanced aerospace composite structures. Further, the CNT attachments on CF led to increased electrochemical capacitance properties by rapid ion diffusion through active CNT sites and defects created during

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