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High-strength Graphene and Polyacrylonitrile Composite Fiber Enhanced by Surface Coating with Polydopamine

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Abstract

Carbon fibers are well-known reinforcing elements in advanced composites, but these materials remain expensive partly due to the complex processing methods used to form high strength and high modulus fibers. Graphene is seen as an alternative precursor for the formation of high strength carbon-based fibers. Here it is shown that the strength and modulus of graphene-based fibers are enhanced by incorporating a polyacrylonitrile (PAN) binder, surface coating with polydopamine (PDA) and through appropriate pyrolysis heat treatments. Fiber samples were prepared by a wet-spinning method such that the composition of liquid-crystalline graphene oxide (LCGO) and PAN could be varied over the full range. The maximum fiber mechanical strength (220 MPa) and modulus (19 GPa) occurred at a composition of LCGO (80 wt%) and PAN (20 wt%). The mechanical strength was further significantly increased to 526 MPa