Advancing Energy Storage Materials through the Development of Quasi-Aligned Graphene Fibers with Enhanced Thermal and Electrical Conductivities

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In the realm of materials science, novel graphene fibers exhibit a higher thermal conductivity than many other common metals such as copper or aluminum. Graphene fibers can therefore effectively dissipate heat and conduct electricity, and their performance is further enhanced both through well-aligned and abundant graphene sheets. Here, I report the development of highly-crystalline graphene fibers exhibiting enhanced electrical and thermal conductivity. To form the graphene fibers, both small-sized and large-sized graphite oxide precursors were manually wet-spun in a calcium chloride coagulation bath. Afterwards, these fibers were sintered at two temperatures, 1800 and 2400 oC, in order to remove all the oxygen functional groups and excess defects to form highly-crystalline graphene fibers. X-ray diffraction (XRD), X-ray photo-electron spectroscopy (XPS), and Raman spectroscopy results indicate a significant reduction of the oxygen groups and a promising, near-graphite crystallinity that increases with increasing temperature. Notably, the graphene fibers annealed at 1800 oC comprised of 30% small-sized GO and 70% large-sized GO exhibited the highest conductivity, as the ratio was optimized to account for both good alignment and high material density. The 30% small-sized GO fiber composition yielded the highest thermal conductivity of 600 W/m-K and the highest electrical conductivity of 1.07 x 10^5 S/m.

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