Highly Electrically Conductive Biomass-Derived Carbon Fibers

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I developed a novel process to create bamboo cellulose derived carbon fibers via Joule-heating, based on my hypothesis that Joule-heating repairs defects in carbonized bamboo fibers by providing energy for atomic-scale reorganization of carbon atoms into conductive graphite crystals. Joule-heating is a method of quick ohmic heating that can achieve high temperatures of ~2000°C within a few seconds. Carbon fibers are highly conductive, and chemically inert, making them useful in many diverse applications. Currently, however, most carbon fiber is derived from fossil fuel precursors, and many biomass-derived carbon fibers fall short in producing high electrical conductivities. If viable processes could be developed to produce carbon fiber from biomass, sequestering carbon from the atmosphere would be an additional benefit. Carbon fibers made with my process were characterized by scanning electron microscopy, thermogravimetric analysis, Raman spectroscopy, and conductivity measurements, and demonstrate high electrical conductivity (25,300 ± 6270 S/m). This scalable process could also sequester significantly more carbon compared to existing carbon fiber production methods because it comes from biomass and bamboo in particular. Compared to existing biomass-derived carbon fibers, the fabrication method I developed is inexpensive and produces fibers with very high electrical conductivity, suggesting my fibers could be used in low-cost, high quantity applications such as smart construction, composites made with resin or thermoplastic impregnation, conductive textiles, and battery anodes.

Awards Won:
Second Award of $2,000
YM American Academy: Second Award of $1000
Serving Society Through Science: Second Award of $500