A New Class of Thermoelectric Material – Electrical Power From Coconut-Fibers and Carbon Nanoparticles

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Thermoelectric materials convert thermal energy directly into electrical energy based on Seebeck effect. An effective thermoelectric material must simultaneously possess a low thermal conductivity, a high electrical conductivity, together with a high Seebeck coefficient. However, most of the existing thermoelectric materials require complex fabrication procedures with high material cost that limit applicability. In this project, carbon nanoparticles, which possess a controllable electrical conductivity, are deposited onto coconut fibers, a material with an extremely low thermal conductivity, to form a functional thermoelectric material. By adjusting the quantity of carbon nanoparticle loaded onto a bundle of coconut-fiber, a higher thermoelectric figure-of-merit can be achieved. In one representative compound, namely CC80, consists of 80 mg of 90 nm carbon nanoparticles embedded in 1000 mg of 150 aligned coconut-fibers, packed into a cylindrical compact of 8 mm in diameter and 10 mm in length. CC80 gives a thermoelectric figure-of-merit as high as 0.23 at 300 K. At a temperature difference of 21 K between the two ends, CC80 able to generates a thermal current of 8 mA with an end voltage of 0.5 V. In addition, CC80 can also acts as a temperature-safety switch as the electrical conductivity decreases when the temperature difference at the two ends exceeds 21 K. Thermoelectric functionalities of other coconut-fibers-carbon-nanoparticles compacts formed using various sizes of carbon nanoparticles and packing densities will also be presented.

Awards Won:
Third Award of $1,200