Boron-doped single-walled carbon nanotubes for flexible thermoelectric generators

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A combined experimental and theoretical work demonstrates that boron atomic doping is an efficient way to simultaneously improve Seebeck coefficient (S) and electrical conductivity (σ) of single-walled carbon nanotube (SWCNT) networks, which could be components of efficient thermoelectric energy harvesting devices. [1.2] Grams of doped nanotubes were synthesized via treatment of pristine SWCNTs in molten B_2O_3 and tested as thin films. Elemental analysis and Raman measurements show that a few tenths of at.% of substitutional boron atoms implanted inside the lattice of the nanotubes lead to an increased thermoelectric power factor by a factor of 2.5 comparing to the pristine tubes. This value is larger than previously observed one in SWCNT-polymer hybrids. First-principle calculation indicates that the higher hole charger concentration in semiconducting SWCNTs is the mainly reason of the slightly improved S. The high σ of the doped SWCNT networks is attributed to the improved electrical transport between laterally contacted metallic and semiconducting nanotubes. The doped tubes are stable over high temperature annealing and processing in liquid phase, which inspired us to fabricate thermoelectric modules by a low-cost ink printing method. This work provides a facile production strategy and meaningful insights for boron-doped SWCNTs suitable for thermoelectric applications.

References

[1] McGuire, K., et al. *Carbon* 43.2 (2005): 219-227.
[2] Blackburn, Jeffrey L., et al. *Advanced Materials*30.11 (2018): 1704386.

Figures

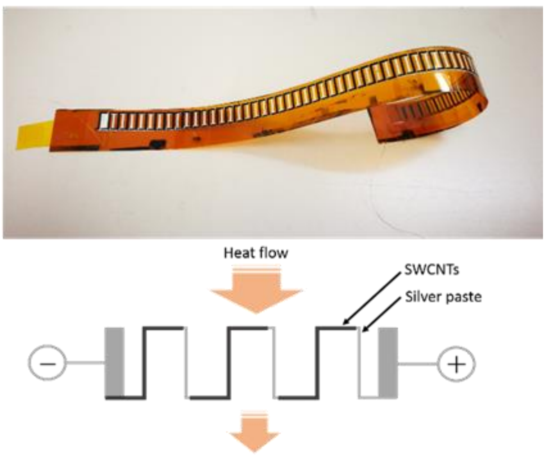

Figure 1: Ink printed SWCNT based flexible TE generator and its schematic representation.