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Research on thermoelectric properties in doped C_{60}.

In the current renewable energy technology research, thermoelectric materials have attracted much attention for applications in power-generation devices that are designed to convert thermal energy and waste heat to electricity. The thermoelectric devices can be used for thermal energy and waste heat harvesting, remote electric power supplies, nano- or micro-power devices, and other applications. Thermoelectric devices are also used in advanced solid-state refrigeration for thermal energy removal. Thermoelectric devices have no moving parts, thus no noise and less maintenance requirement in operation; long operation life time; precise temperature control to within 0.1°C; and safe operation under harsh environment. However, the energy conversion efficiency of thermoelectric materials must be improved, before they can be widely deployed for large scale applications.

We have investigated the thermoelectric and electronic transport properties of bulk C_{60} samples doped with Bi and P. The samples were prepared via solid state reaction. The measurements showed that the materials have extremely low thermal conductivity, typically in the range of 0.1 - 0.3 W/Km at room temperature. The electrical resistivity of the samples show well behaved $\exp[1/T^{\upsilon}]$ temperature dependence over the entire temperature range of the measurements and over a resistance change of 5-6 orders of magnitude for Bi doped C_{60} bulk samples. The exponent υ exhibits a crossover from ¼ to ½ as the Bi doping level increases from Bi:C = 1:600 to Bi:C = 1:60, reflecting changes from the Mott variable range hopping in Bi-doped C_{60} to intergranular tunneling between Bi nanoparticles across C_{60} barriers. For P doped C_{60}, we have observed very large thermoelectric Seebeck coefficient in the order of 10^3 μV/K.