Simultaneous enhancement of thermoelectric properties with "invisible" dopants

Abstract

In this talk, I will describe our recent pursuit of a strategy to improve Seebeck coefficient and electrical conductivity, which are usually contra properties, of thermoelectric materials at the same time. I will start with a discussion of the origin of this correlation and introduce our new concept of "invisible doping", where the dopant nanoparticles are engineered in such a way that they are transparent to conducting electrons with certain energy, as if they were "cloaked away" from the electrons, leading to reduced scattering and thus an improved electrical conductivity compared to traditional doping techniques. We designed these nanoparticles with inspirations from the optics community where techniques of designing optical cloaks had been developed. As a bonus, the sharp transition of the scattering rate within the relevant energy range also gives rise to a better Seebeck coefficient. A realistic calculation in the case of GaAs was carried out and significant simultaneous enhancements were observed at low temperatures. This concept of "invisible doping" and our design strategy can be applied in a wider context for different applications. At the end of the talk I will demonstrate designing "electron cloaks" on a graphene sheet using proper top gate electrodes.

For additional information about this and other upcoming seminars, please visit http://drl.mit.edu/micro_nano_seminar_series.html

Light refreshments are available a few minutes beforehand in the hallway just outside Room 3-333. For more information, please contact Theresa Werth at theresaw@mit.edu.