Hybrid Materials for Thermoelectric Applications

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Abstract

Currently energy and environment are of major concern for the future. Thermoelectric materials are interesting due to their ability to convert energy for cooling (Peltier effect) and electric power generation (Seebeck effect). It is known that the performance of thermoelectric materials depends on the dimensionless figure of merit, ZT.
ZT = T (α^2 / ρ*) , where T is the temperature, α is the Seebeck coefficient, ρ is the electrical resistivity and is the thermal conductivity. Based on this relationship, a good thermoelectric material would be a compromise between a good electronic conductor (metal) and a good thermal insulator (insulating material). In other words, a degenerate semiconductor or a highly doped semiconductor could be a good candidate for this work. Presently, for the best known materials, ZT values at room temperature are close to one.

These main characteristics demonstrate an interesting aspect of hybrid materials and present an innovative alternative to oxide or intermetallic materials. Indeed, hybrid thermoelectric materials can combine an organic network (bad thermal conductivity) and an inorganic network (good electronic conductivity and charge capacity), particularly when it has low dimensionality (1D, 2D).
These materials are made of an organic network connected to an inorganic network whose composition and structure can be tuned in order to obtain desired properties. Also, they can be used as host structures for the *in-situ* polymerization of conducting polymers.

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