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Role of structures on thermal conductivity in thermoelectric materials

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The figure of merit $ZT = \sigma S^2 T/\kappa$ (S the Seebeck coefficient, σ and κ the electrical and thermal conductivity respectively) is an essential element of the efficiency of a thermoelectric material for applications, which convert heat to electricity or, conversely, electric current to cooling. From the expression of the power factor $\sigma S^2 T$ it was deduced that a highly degenerated semiconductor is necessary. In order to reduce the lattice part of the thermal conductivity, various mechanisms, mainly related to the structure of the materials, have been tested in new thermoelectric materials and have been the topics of different reviews. This include cage-like materials, effects of vacancies, solid solutions, complex structures (cluster, tunnel, ...), nano-structured systems. We plan to review structural aspects in the modern thermoelectric materials and include results of the very last years in such view. Moreover, as micro- and nano-composites seem to be promising to increase ZT in large size samples, we will also briefly discuss the interest of spark plasma sintering technique to preserve the micro- or nano- structure in highly densified samples.