Nanoengineering Thermoelectrics for Energy Harvesting.

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The growing social alarm over increasing energy cost and global warming related to fossil fuel sources has motivated the search for cleaner, more sustainable energy sources. Among the different feasible technologies, thermoelectric (TE) devices have received attention as these solid-state devices can generate electricity by harvesting waste thermal energy, thereby improving the efficiency of a system. The many advantages of TE devices include solid-state operation, no noise, zero-emissions, vast scalability, no maintenance and a long operating lifetime. The efficiency of TE materials is directly related to a dimensionless figure of merit (ZT). In order to compete with conventional refrigerators, a ZT=3 must be obtained. Although, a device with ZT>2 will be also important in other applications. Due to their limited energy conversion efficiencies (i.e. ZT is ≈1), thermoelectric devices currently are only present in niche applications.

However, there is a renewed interest in the field of thermoelectrics due to quantum size effects, which provide additional ways to enhance energy conversion efficiencies in nanostructured materials. For example, a ZT up to 2.5 was achieved by synthesizing two-dimensional Sb_2Te_3/Bi_2Te_3 superlattice thin films through a chemical vapor deposition (CVD) process, exceeding previous limits of ≈1 for bulk counterparts; theoretical calculations predict that even higher ZTs can be achieved in one-dimensional nanowires.

The successful application of these nanostructures in practical thermoelectric devices must implement a cost-effective and high through-put fabrication process. Among the different techniques electrodeposition has been one of the more successful. For that reason an overview of the state of the art in the electrodeposition, of films and nanowires, of the different thermoelectric: Chalkogenide, Silizide SiGe, TAGS, Skutterudites, Clathrates, etc will be presented here.

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