Semiconducting Glasses: A New Class of Thermoelectric Materials?

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Abstract:
The development of the "Phonon Glass and Electron Crystal" (PGEC) idea led to a better understanding of the mechanisms affecting the phonon propagation, without altering the electrical charge propagation. Several general rules to increase the thermoelectric efficiency were launched, the most important ones being the use of compounds with complex crystal structures, the presence of heavy atoms weakly bounded to the structures, the existence of inclusions and/or impurities, the formation of solid solutions and the existence of a large number of grain boundaries.

Glasses can have most of these characteristics. However, the high degree of disorder usually produces broad electronic bands (leading to low Seebeck coefficients) and large electron scatterings (implying low electrical conductivities) and, consequently, low power factors. Therefore, the question if there is any type of glasses suitable for thermoelectric applications must be raised.

We have recently showed that some semiconducting glasses can have interesting thermoelectric properties [1,2]. In this contribution a review on semiconducting glasses for thermoelectric applications will be made, being presented several examples of semiconducting glasses showing high Seebeck coefficients, very low thermal conductivities and tunable electrical conductivities. In particular, the case of chalcogenide glasses will be stressed, pointing for this family of glasses as a good candidate for high-performance thermoelectric materials.

References:

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