Approaches for the development of new thermoelectric materials: the chalcogenide glasses case

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Resume : The increase of the figure of merit of thermoelectric materials is one of the main challenges of our scientific community. The usual way to obtain new high ZT materials is to start with a material with good electrical transport properties (low electrical resistivity, high Seebeck coefficient) and try to decrease the thermal conductivity while keeping the electronic properties unchanged. An example of this is the recent development on skutterudites. However, other strategies can be considered, as the design and synthesis of original compounds with suitable properties or the exploration of multicomponent systems with complex crystal structures. Recently, we have adopted a new approach: start with a material with low thermal conductivity and try to improve its electrical transport properties. A priori, the glasses, which have some of the lowest known thermal conductivities, are good candidates for starting materials in this approach. However, care must be taken, as for most of them lack the "electron-crystal" properties. Therefore, low gap semiconducting glasses, as chalcogenide glasses, must be considered in these studies. Here, we report our recent studies on chalcogenide glasses as thermoelectric materials. In particular, we present results on the $Cu_{x+y}Ge_{20-x}Te_{80-y}$ and $Cu_xAs_{45-x}Te_{55}$ families of glasses that clearly show the validity of this approach on the development of new high-performance thermoelectrics. Exploratory data on chalcogenide glass ceramics are also shown.