New developments on Thermoelectric Materials: reducing scale and dimensionality

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Thermoelectric materials are able to convert a gradient of temperature in a diference of voltage, or vice versa. In order to improve the thermoelectric efficiency of these materials for actual applications, one of the most studied routes is the reduction in the dimensionality, via nanowire fabrication, for instance. This gives rise to a reduction of the thermal conductivity of the material due to the increase of phonon dispersion in the surface of the nanowires [1]. Another route to decrease the thermal conductivity would be the fabrication of interconnected three-dimensional structures, which could be seen as an intricate net of nanowires with many connection points, which increases the phonon dispersion and thus reduces the thermal conductivty.

We will review these kinds of structures along with the latest developments of template assisted electrochemical deposition of thermoelectric materials in three-dimensional templates. In this case, the reduction in thermal conductivity is due to the resulting interconnected three-dimensional structure that enhances the phonon scattering; compared with bulk, thin films or nanowires.

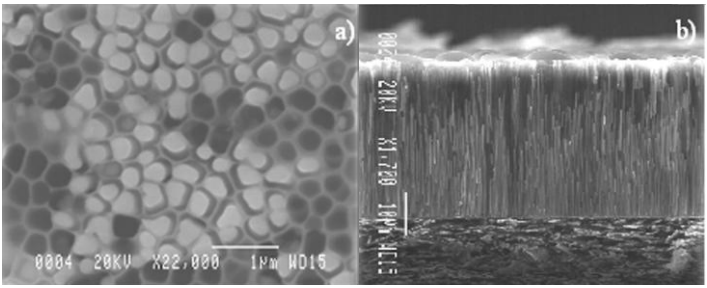

Fig1. SEM image of a) top view of an alumina matrix partially filled with Bi_2Te_3 nanowires (200 to 400 nm wire diameter) and b) cross section view of the same sample before polishing (taken from [2])

References

[1] Olga Caballero-Calero, Marisol Martín-González, Scripta Materialia 1 (2016) 54

[2] M. Muñoz-Rojo, S. Grauby, J.M. Rampnoux, O. Caballero-Calero, M. Martín-González, J. Appl. Physics 113 (2013) 054308