Electrodeposition of Co-Sb thick films and their thermoelectric properties in DMSO

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Abstract

In the last decade there has been an increasingly interest in the Skutterudites in the field of thermoelectricity [1]. This interest is based on the fact that the highest performance of this material happens at 400ºC, which makes it ideal for multiple applications as energy harvesting devices. Generally, most of the actual compounds working under these conditions are unstable or presents a low figure of merit [2]. However, Skutterudites have usually good values of the power factor, but also they offer the possibility of an enhancement of their efficiency due to the reduction of the thermal conductivity via doping the structure [3] or filling of the voids [3] of the structure with heavy atoms. Nevertheless, to obtain the right phase by electrodeposition is still not a solve question. [4]

This work deals the electrodeposition of Skutterudite ($CoSb_3$). We have been able to grow $CoSb_3$ films via electrochemical deposition in an organic solvent (DMSO). After studying different parameters such as temperature, stirring, time of deposition or potential, we have been able to obtain quite homogeneously films with 1:3 ratio.

For the first time, thermoelectric properties have been measured in different labs, to measure the Seebeck coefficient and electrical conductivity of the films in plane, and using a Seebeck microprobe system, to measure and make a map of the Seebeck coefficient in cross-plane. We determine the Seebeck coefficient to be -12 µV/K in plane and -37 µV/K out of plane, and an electrical conductivity of around 9 S/cm in plane.

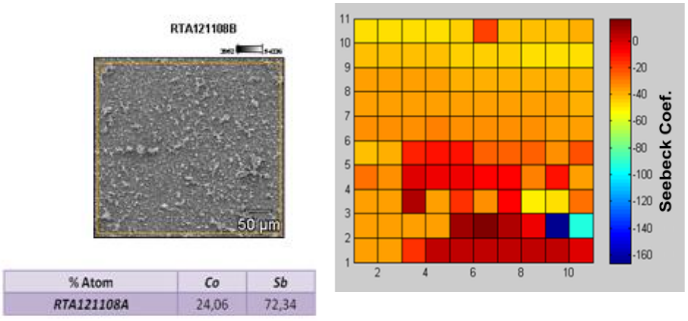

Figure 1.a Scanning Electron Microscopy and Energy Dispersive X-Ray Analysis of a $CoSb_3$ film.
1.b. Seebeck microprobe map

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