

# Systematic Study About the Annealing of Skutterudite $\text{Sm}_y(\text{Fe}_x\text{Ni}_{1-x})_4\text{Sb}_{12}$ Thin Films

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This work is aimed to accomplish a systematic study regarding the annealing of thermoelectric (TE) skutterudites thin films prepared by the Pulsed Laser Deposition (PLD) method. The advantages of thin films rely on their essential properties depicting significant advantages for developing TEs: flexibility, low dimensionality, fast fabrication, control of strain at the interface with substrates. Besides, rare-earth (RE) filled skutterudites represent a fascinating category of TE compounds by reason of their high stability and possibility to modulate the  $n$  or  $p$  behaviour by slightly varying the composition [1]. The research group involved in the present work already deeply studied bulk materials of RE-filled skutterudites [2-4] while there is a lack of literature on the RE-filled skutterudites thin films.

As a consequence of a separate study regarding the power factor of the same type of samples [5], it is clear the utmost importance of a systematic study to optimize the annealing process to enhance the thermoelectric properties of these samples. Three batches of thin films of different compositions ( $\text{Sm}_y(\text{Fe}_x\text{Ni}_{1-x})_4\text{Sb}_{12}$  with  $x = 0.50, 0.63$  and  $0.70$ , being the carrier transport type  $n$ ,  $n/p$  and  $p$ , respectively [3]) were deposited on fused silica under vacuum ( $10^{-4}$  Pa) at room temperature. Afterwards, every sample of each composition underwent to an annealing process varying the temperature ( $150^\circ\text{C}$ ,  $200^\circ\text{C}$ ,  $250^\circ\text{C}$ ,  $300^\circ\text{C}$ ) and the time (set  $a = 3$  h, set  $b = 6$  h). At the present day, room temperature Seebeck coefficient ( $S$ ) was measured by means of a PTM-3 portable device [6] and XRD analysis were performed as well. As a first result, the higher temperature of  $300^\circ\text{C}$  is causing the degradation of the sample, while  $250^\circ\text{C}$  is appearing to have the best effect on the  $S$ : the higher value is  $71.2 \mu\text{V/K}$  for the  $x = 0.63$  sample annealed at  $250^\circ\text{C}$  for 6 hours. All XRD patterns confirm the result also found in [5], showing the appearance of the crystalline structure of the skutterudite as a consequence of the annealing performed on amorphous thin films. Further characterizations will be reported at the conference.

## References:

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