Improving the Thermoelectric Properties of α-MgAgSb through powder Atomic Layer Deposition

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In recent years, Mg-based materials have started rivalling the performance and reliability of commercial Bi_2Te_3 thanks to doping and phase engineering [1]. Through the application of Powder Atomic Layer Deposition (pALD) on thermoelectric powders, it is possible to create heterogeneous interfaces at grain boundaries. This modification alters carrier and phonon scatterings, ultimately enhancing the material's thermoelectric performance [2]. In our study, we investigate the impact of coating α-MgAgSb with Sb_2Te_3 layers using pALD. The results indicate a consistent and linear decrease in total thermal conductivity as the number of coating cycles increases. To the best of our knowledge, this study marks the first report on the use of non-oxide pALD coatings for thermoelectric optimization. Our findings underscore the efficacy of pALD in reducing thermal conductivity, thereby opening up new avenues for future research on the deposition of oxygen-free semiconductors and pure metals at grain boundaries. This innovation holds promise for further advancing the field of thermoelectric materials.

Keywords: Thermoelectric, Grain boundary engineering, α-MgAgSb, Powder Atomic Layer Deposition

Acknowledgments

We acknowledge the financial support by the strategic project at IFW Dresden on “Tellurium-Free Thermoelectric Modules by Interface Engineering – Thermos”

References:

[1] Ying, P., He, R. Towards tellurium-free thermoelectric modules for power generation from low-grade heat. Nat Commun. 12, 1121 (2021).
[2] He, S., Bahrami, A. Effect of Powder ALD Interface Modification on the Thermoelectric Performance of Bismuth. Adv Mater Technol, 7 (5), 2100953, (2021)