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Contributions to physical clarification of high ZT-Bi_2Te_3/Sb_2Te_3 nanoscale superlattices.[1]

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Since the 1990's it is well known, that nanostructuring of thermoelectric(TE) Materials should reduce the lattice part of the thermal conductivity and therefore increase the ZT-value. With this knowledge in 2001 Venkatasubramanian et al. [1] achieved the breakthrough of the ZT=1 wall. By using nanofabricated superlattice structures of p-type Bi_2Te_3/Sb_2Te_3 they obtained a ZT of 2.4 (see Figure 1) and ZT=1.5 for n-type $Bi_2Te_3/Bi_2Te_{2.83}Se_{0.7}$.

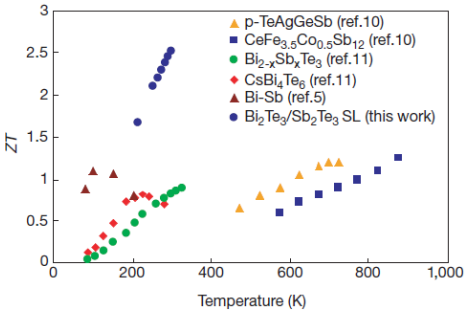

Figure 1: ZT-results of Venkatasubramanian et al. [1] in comparison with other thermoelectric materials without superlattice structure.(For mentioned references see [1].)

In normal case MBE processes are used to deposit nanoscale multilayered films and superlattice structures [2]. For the mass production of thin film TE-devices an established high throughput technique like sputtering or electroplating for the film preparation would be more preferable. For example multilayered magnetic films, used in up-to-date hard drives, are sputtered in inline processes with throughput rates up to m^2/min [3].

As Fraunhofer IPM had already an expertise in nanoalloying of thermoelectric thin films, a project was started to fabricate nanoscaled superlattice structures using nanoalloying of sputtered films. The combination of sputtering and nanoalloying seems to be a promising way for future TE-device manufacturing.

This talk will give an overview of Fraunhofer IPM's efforts for the online ZT-determination for bulk as well as thin film TE-materials and the results we obtained using these techniques within our superlattice project.

[1] R. Venkatasubramanian et al. Nature **413**, 597 (2001).
[2] H. Beyer et al. Physica E **13**, 965 (2002).
[3] F. Springer; Diploma Thesis *"Magnetic and structural properties of granular CoCrPt films"* University of Konstanz (2007).

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