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## Optimizations of Pulsed Plated p and n-type $Bi_2Te_3$-Based Ternary Compounds by Annealing in Different Ambient Atmospheres

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This work presents a comprehensive study of the fabrication and optimization of electrodeposited p – and n – type thermoelectric films. The films are deposited on Au and stainless steel substrates over a wide range of deposition potentials. The influence of the preparative parameters such as the composition of the electrolyte bath and the deposition potential are investigated. In addition, a tailor – made n – type thermoelectric ternary compound $(Bi_{1-x}Sb_x)_2Te_3$ by combining both the p – type SbTe and n – type BiTe electrolyte baths is examined as well. Then, the p-doped $(Bi_xSb_{1-x})_2Te_3$ and the n – doped $Bi_2(Te_xSe_{1-x})_3$ films are annealed for a period of about 1 h under helium and under tellurium atmosphere at 250 °C for 60h. Annealing in He already leads to significant improvements in the thermoelectric performance. Furthermore, due to the equilibrium conditions during the process, annealing in Te atmosphere leads to a strongly improved film composition, charge carrier density and mobility. The Seebeck coefficients increase to values up to +182 μV $K^{-1}$ for p – doped and –130 μV $K^{-1}$ for n – doped materials at room temperature. The power factors also exhibit improvements with 1320 μW $m^{-1}$ $K^{-2}$ and 820 μW $m^{-1}$ $K^{-2}$ for p – doped and n – doped films, respectively. Additionally, in-situ XRD measurements performed during annealing of the films up to 600K under He atmosphere show stepwise improvements of the crystal structure leading to the improvements in thermoelectric parameters. A thermal conductivity between 1.2 W $m^{-1}$ $K^{-1}$ and 1.0 W $m^{-1}$ $K^{-1}$ has been determined.