Effect of substrate temperature on thermoelectric performance of CdO thin films

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Recently, many researchers are working on thermoelectric (TE) materials to improve their electrical conversion efficiency from waste heat energy sources. In the present work, we studied the effect of the substrate temperature on the TE properties of cadmium oxide (CdO) thin films. Nanostructured CdO films with granular morphology were prepared via chemical spray pyrolysis technique with different substrate temperatures of 200 °C, 250 °C, 300 °C, 350 °C and 400 °C. The prepared CdO films are polycrystalline with preferred cubic structure oriented along (200) direction. The nanostructured grains size is increased with increasing substrate temperature up to 350 °C while at 400 °C they coalesce in clusters. The optical bandgap is gradually increased with respect to substrate temperature. According to the room temperature Hall measurement, the electrical resistivity (ρ) is decreased from 2.4×10^{-5} Ωcm (T_{dep} =200 °C) to 0.75×10^{-5} Ωcm (T_{dep} = 300 °C) due to increasing carrier concentration of the films. The temperature dependent Seebeck coefficient (S) value increases with measuring temperature for all films, and the largest value is reached by the film deposited at 300 °C with S = -75 μW/K. The maximum calculated power factor (PF) is 1.2 (mW/mK^2) for the film deposited at 300 °C due to its maximum electrical conductivity and Seebeck coefficient values. The PF, quite large for an oxide thin films, suggests that spray deposited CdO thin film can be used to fabricate good oxide materials based thermoelectric devices.