Oxide and organic thin-film thermoelectrics

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While the thermolectric effect has been known for decades, a resurgence of interest in thermoelectrics began in the mid-1990s when theoretical predictions suggested that thermoelectric efficiency could be greatly enhanced through nano-structural engineering, which led to experimental efforts demonstrating proof-of-principle high-efficiency materials. In this work, we present results from two different studies to exploit the role of nanostructures in improving two very different class of materials. In the first example, $Ca_3Co_4O_9$ thin films were grown on cubic perovskite substrates and on hexagonal Al_2O_3 sapphire substrates using the pulsed laser deposition technique. A detailed TEM and XRD data allowed a correlation of the oxide structures to the measured Seebeck coefficients. In the second study, nanocomposites of the conducting polymer PEDOT:PSS and Te and Bi_2Te_3 nanorods were made by aqueous solution chemistry. Thin films were made by drop casting and annealing. The electrical conductivity of the nanocomposite thin films was increased by over two orders of magnitude with only ~ 6 wt.% Te nanorods. These polymer thin films so promise for room temperature thermoelectric applications.