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Self-supporting ($\mathbf{Bi_{0.11}Sb_{0.29}}$)($\mathbf{Te_{0.25}}$,$\mathbf{Se_{0.41}}$) nanowire arrays for thermoelectric microdevices HATEM EL MATBOULY, TIMOTHY SANDS, KALAPI BISWAS, Purdue University — Nanostructuring of thermoelectric material can lead to improved performance through suppression of the lattice contribution to thermal conductivity and enhancement of the power factor by quantum confinement or thermionic energy filtering. To take advantage of these effects in a Peltier microcooler or Seebeck generator, it is necessary to prepare nanostructure materials with leg lengths ranging from tens of microns to millimeters. We have developed a process for fabrication of thick, self-supporting ($Bi_{0.11}$,$Sb_{0.29}$)($Te_{0.25}$,$Se_{0.41}$) nanowire arrays using a novel branched porous anodic alumina template that can be removed completely by selective etching following electrodeposition of the thermoelectric material, resulting in 100-micron-thick nanostructured thermoelectric material without the parasitic thermal shunt that is associated with the template. The electrodeposition process allows composition modulation and grading, effects that are difficult to achieve by bulk synthesis. Bandgaps of the electrodeposited material range from 0.13 eV for Bi_2Te_3 to an optical gap of 0.52 eV measured for a $(Bi,Sb)_2(Te,Se)_3$ alloy, suggesting an operating tempurature range from below room temperature to $\sim$300 $^\circ$ C.

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