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Large cooling differentials and high heat flux capability with p-type Bi_2Te_3/Sb_2Te_3 and n-type $Bi_2Te_3/Bi_2Se_xTe_{3-x}$ Superlattice Thermoelectric Devices GARY BULMAN, RTI International, ED SIIVOLA, Nextreme Thermal Solutions, RYAN WIITALA, BRIAN GRANT, RTI International, JONATHAN PIERCE, Nextreme Thermal Solutions, RAMA VENKATASUBRAMANIAN, RTI International — Thin film superlattice (SL) based thermoelectric (TE) devices offer the potential for improved efficiency and high heat flux cooling over conventional bulk materials. Recently, we have demonstrated external cooling of 55K and heat pumping capacity of 128 W/cm^2.[1] These high heat fluxes in thin film devices, while attractive for cooling hot-spots in electronics, also make the device performance sensitive to various thermal resistances in the device structure. We will discuss advances in the cooling performance of Bi_2Te_3-based SL TE devices and describe a method to extract device material parameters, including thermal resistance, from measurements of their ΔT-I-V characteristics. These parameters will be compared to values obtained through Hall and Seebeck coefficient measurement on epitaxial materials. Results will be presented for both single couple and multi-couple modules, as well as multi-stage cascaded devices made with these materials. Single stage cooling couples with ΔT_{max} of 57.8K (T_c $\sim$242K) and multi-stage modules with ΔT_{max} $\sim$92.2K (T_c $\sim$209K) have been measured.

[1.] G.E. Bulman, E. Siivola, B. Shen and R. Venkatasubramanian, Appl. Phys. Lett. 89, 122117 (2006).

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