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High-temperature ZT of InGaAlAs Thin Films with Embedded ErAs Nanoparticles RAJEEV SINGH, ZHIXI BIAN, YOUNES EZZAHRI, ALI SHAKOURI, Electrical Engineering Department, University of California, Santa Cruz, GEHONG ZENG, JOHN BOWERS, Department of Electrical and Computer Engineering, University of California, Santa Barbara, JOSHUA ZIDE, ART GOSSARD, Materials Department, University of California, Santa Barbara — We have measured the thermoelectric (TE) figure-of-merit (ZT) of InGaAlAs thin films with embedded ErAs nanoparticles over a wide temperature range (300K - 650K). This material system is currently being explored for use in power generation applications such as waste heat recovery. A novel high-speed measurement system was developed to measure the ZT of thin films of thicknesses on the order of 1um with a transient thermal signal resolution of 200ns at temperatures up to 900K. In order to resolve the intrinsic ZT of thin-film materials, TE devices were fabricated to minimize electrical and thermal parasitics and differential measurement was employed on TE devices of varying film thicknesses. The improvement in ZT of the material with ErAs nanoparticles embedded in the semiconductor matrix is verified throughout the temperature range. The increase in TE ZT is found to be mainly due to the reduction in material thermal conductivity due to phonon scattering by the ErAs nanoparticles.

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