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Solid State Thermionic Energy Conversion[1]

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An overview of the activities at the Thermionic Energy Conversion Center will be given. This is a consortium of twelve research groups that are working to optimize thermoelectric properties of embedded metallic nanoparticles and multilayers. Hot electron filtering using heterostructure barriers is used to break the trade off between high Seebeck coefficient and high electrical conductivity. Embedded ErAs nanoparticles and metal/semiconductor multilayers are used to reduce the lattice thermal conductivity without significant effect on electrical conductivity. The implication of the superlattice transport on the electronic thermal conductivity and Lorenz number will also be discussed. Cross-plane and in-plane thermoelectric properties are characterized in a wide temperature range. The effective ZT of the thin film is measured using the transient Harman technique. Integrated circuit fabrication techniques are used to transfer the n- and p-type thin films on AlN substrates and make power generation modules with hundreds of thin film elements. Potential for energy conversion efficiency exceeding 20% and high power density >1W/cm2 will be discussed.

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