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High Temperature Thermoelectric Properties of Gd doped InGaAs Thin Films[1] RACHEL KOLTUN, RYAN NEED, ASHTON MEGINNIS, University of California, Santa Barbara, Materials Department, BRIAN SCHULTZ, University of California, Santa Barbara, ECE Department, CHRIS PALMSTROM, JOHN BOWERS, University of California, Santa Barbara, Materials and ECE Departments — Doping III-As thin films with rare earths has been shown to increase the thermoelectric figure of merit (ZT) at high temperatures. Above the solubility limit, rare earth - arsenide nanoparticles precipitate out of molecular beam epitaxy grown films. These particles scatter phonons to reduce the thermal conductivity and act as a source of thermally activated carriers at high temperature. In this study, we compare the thermoelectric properties of Gd doped InGaAs to traditional doping methods (Si). Gd doped samples were grown to explore the doping effects below and above the solubility limit in InGaAs. This range also captures the peak ZT for these structures. Electrical conductivity and Seebeck coefficient were measured as a function of temperature. Gd doped InGaAs shows a higher doping efficiency than Er doped InGaAs, leading to better thermoelectric performance. However, Si has a much higher doping efficiency than any of the rare earths, leading to overall peak room temperature thermoelectric performance of Si doped InGaAs. Temperature dependent hall suggests that there may be a crossover point where enough carriers are thermally generated from nanoparticles to surpass the thermoelectric performance of Si doped InGaAs.

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