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Chemical Doping Effect on the Thermoelectric Properties of TGa$_3$(T = Fe, Ru, Os) NEEL HALDOLAARACHCHIGE, AMAR KARKI, ADAM PHELAN, YIMIN XIONG, RONGYING JIN, JULIA CHAN, SHANE STADLER, DAVID YOUNG, Louisiana State University, USA — Thermoelectric properties of chemically-doped intermetallic narrow-band semiconductors: TGa$_3$(T = Fe, Ru, Os) are reported. The parent compounds show semiconductor-like behavior (E_g $\sim$ 0.2 eV, n_{290K} $\sim 10^{18}$cm^3) with large $n-$type Seebeck coefficients at room temperature ($S_{290K} \sim$ -300 μV/K). The semiconductor-like FeGa$_3$ becomes metallic upon chemical doping (adding electron carriers), but RuGa$_3$ and OsGa$_3$ remain semiconducting. While the electrical resistivity and the Seebeck coefficients of all the compounds decrease with electron doping, the Seebeck coefficients remain fairly large and $n-$type, which leads to larger power factors than those of the pure samples. The thermal conductivity (κ_{290K}= 1.6 W/m K) of electron-doped FeGa$_3$ decreases, which increases the room temperature power factor by a large percentage ($S^2/\rho_{290K} = 60$ μW/m K^2) over that of pure FeGa$_3$. This improvement in the power factor leads to a corresponding enhancement in the thermoelectric figure of merit (ZT) – a factor of 5 increases above undoped polycrystalline FeGa$_3$ and two orders of magnitude improvement over that of pure single crystalline FeGa$_3$.

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