CHARACTERIZATION OF THE THERMAL PROPERTIES OF ENTROPY STABILIZED OXIDES AND HIGH ENTROPY DIBORIDES

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Entropy stabilized oxides and high entropy diborides are promising new materials capable of withstanding extreme environments consisting of high temperatures and pressures. In these novel materials, thermal characterization is essential for understanding and predicting performance at elevated temperatures. Moreover, these systems provide a unique opportunity to study the nature of thermal transport and phonon scattering in multicomponent, high-entropy materials. In this study, we experimentally investigate the thermal conductivities and heat capacities of 5- and 6-component entropy stabilized oxides and high entropy diborides using time- and frequency-domain thermoreflectance to reveal a strong reduction in the lattice thermal conductivity with inclusion of additional metallic components, beyond what is expected for mass-impurity scattering alone. For example, Figure 1 shows that the introduction of a new distinct cation to J14 ($Mg_xNi_xZn_xCo_xCu_xO$, x = 0.2) lowers the thermal conductivity significantly, no matter what the new mass is relative to the average J14 cation mass. Finally, we compare experimental results to analytical and computational results to understand the phonon scattering mechanisms driving the reduction in thermal conductivity.

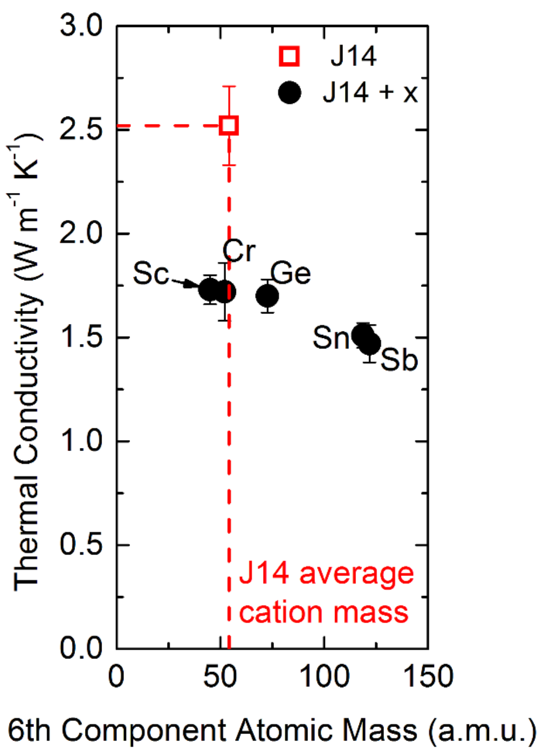

Figure 1 – Room temperature thermal conductivity vs. 6th-component atomic mass for ~100 nm thin film entropy stabilized oxides. For reference, the thermal conductivity of J14 ($Mg_xNi_xZn_xCo_xCu_xO$, x = 0.2) is also shown at its average cation mass.

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