Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Nernst-Ettingshausen Effect in Elemental Rare-Earth Single Crystals[1] AUDREY CHAMOIRE, JOSEPH HEREMANS, The Ohio State University, THERMAL MATERIALS LABORATORY TEAM — The transverse Nernst-Ettingshausen (N-E) coefficient Nmeasurements of the elemental rare-earth (R-E) single-crystal are for the first time presented from 80 to 420 K. Since they have mainly hexagonal symmetry at room temperature, measurements are given with the heat flux along the [100] and the [001] axes. Due to their complex band structure and Fermi surface, their small thermopower (S) and their multicarrier systems involving electron (e) and hole (h) pockets, their N are expected to be large. Indeed, for such systems, both $S$and N can be expressed as[1] $S = (S_e\sigma_e + S_h\sigma_h)/(\sigma_e+\sigma_h)$ while $N = [(N_e\sigma_e + N_h\sigma_h)(\sigma_e+\sigma_h) + (S_h - S_e)(R_{Hh}\sigma_h - R_{He}\sigma_e)\sigma_e\sigma_h]/(\sigma_e+\sigma_h)^a$, where σ is the electrical conductivity and R_H the Hall coefficient and the subscript correspond to either carriers. Since S_h >0 andS_e <0, the resulting S should be low thus leading to a large N . These solids are useful in single-material thermoelectric N-E coolers. They create a large temperature differences using thermomagnetic effects, without having to be cascaded. This would resolve th problem of contact resistances of actual multi-stage Peltier coolers, especially in the cryogenic temperature range. The dimensionless figure of merit of N-E coolers is $zT_N = B^2N^2\sigma(B)T/\kappa(B)$, with B is the magnetic field, T the absolute temperature and κ the thermal conductivity. a.E.H. Putley, *The Hall Effect and Semiconductor Physics* , New York: Dover publication, 1968.

[1]Work supported by DOE-BES Energy Frontier Research Center on Revolutionary Materials for Solid State Energy Conversion, 61-3212B

Audrey Chamoire
The Ohio State University

Date submitted: 10 Nov 2011 Electronic form version 1.4