The Origin of Enhanced High Temperature Electron Transport in Thermoelectric Ca$_3$Co$_4$O$_9$

TAO WU, TREVOR A. TYSON, HAIYAN CHEN, New Jersey Institute of Technology, JIANMING BAI, Oak Ridge National Laboratory, CHERNO JAYE, National Institute of Standards and Technology — Temperature dependent measurements of resistivity, crystal structure and heat capacity reveal significant hysteresis occurring near 400 K in Ca$_3$Co$_4$O$_9$. The largest changes in structure occur in the CoO$_2$ layer associated with electron transport: manifested mainly by $b_2$ axis changes. Application of magnetic fields up to 8 T reduces the area of the resistivity hysteresis loop with saturation at $\sim$4 T. Reduced resistivity associated with this first order phase transition from metallic to semiconducting behavior enhances the thermoelectric properties at high temperatures and points to the metal-insulator transition as a mechanism for improved ZT in high temperature thermoelectric oxide. This work is supported by DOE Grant DE-FG02-07ER46402. The Physical Properties Measurements System was acquired under NSF MRI Grant DMR-0923032 (ARRA award).

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