Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Thermoelectric properties of individual $Bi_{1-x}Sb_xTe_{3-y}$ nanowires YANG-YUAN CHEN, P.C. LEE, G.P. DONG, W.H. TSAI, C.H. CHIEN, M.N. OU, F.Y. CHIU, Academia Sinica, INSTITUTE OF PHYSICS TEAM — The low-dimensional materials exhibit innovative behaviors different from the bulk materials. The tuning of phonon-electron interactions could enhance the energy conversion efficiency of the one-dimensional thermoelectric materials. In order to study the intrinsic thermoelectric properties of an individual nanowire without external interferences, a measurement platform for such a purpose was successfully designed. A single crystalline $Bi_{1.75}Sb_{0.25}Te_{2.02}$ nanowire having thickness 250 nm was grown from a $Bi_{1.5}Sb_{0.5}Te_3$ film via thermal annealing method. The growth direction along [110] and composition of $Bi_{1.75}Sb_{0.25}Te_{2.02}$ for this nanowire were confirmed by TEM results. The self-heating 3ω technique was employed to characterize the thermal conductivity of this nanowire. The thermal conductivity increases from 0.5 W/m-K at 10 K to 1.4 W/m-K at 300 K. It is observed that the phonon drag at 20 K is about 6 times lower than that of $Bi_{0.5}Sb_{1.5}Te_3$ bulk. This enormous thermal conductivity reduction is mainly attributed to the enhanced phonon-boundary scattering of nanosized geometric effects. In the meantime the electrical resistivity and Seebeck coefficient were also measured by the heaters and electrodes built in the platform.

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Date submitted: 15 Nov 2013 Electronic form version 1.4