Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Low-Temperature Absorption Studies in Bismuth Nanowires JASON REPPERT, Clemson University, MALCOLM SKOVE, MARCIE BLACK, MILDRED DRESSELHAUS, APPARAO RAO, SCHOOL OF MATERIALS SCIENCE AND ENGINEERING, CLEMSON UNIVERSITY COLLABORATION, DEPARTMENT OF PHYSICS AND ASTRONOMY; COMSET, CLEMSON UNIVERSITY COLLABORATION, BANDGAP ENGINEERING INC. COLLABORATION, DEPARTMENT OF PHYSICS AND DEPARTMENT OF ELECTRICAL ENGINEERING, MIT COLLABORATION — Bulk bismuth has a small band overlap between the conduction and valence bands and a highly anisotropic electron effective-mass tensor. Previously, we have shown evidence for strong quantum confinement in Bi nanorods with diameters $\sim$10 nm which undergo a transition from a semimetal with a small band overlap to a semiconductor with a small indirect band gap. These quantum confinement effects can be potentially useful in optical and electro-optical devices. Here, we report the low temperature (77 K) optical absorption properties of $\sim$10 nm diameter Bi nanorods using Fourier Transform Infrared spectroscopy. The Bi nanorods exhibit a strong absorption peak ($\sim$1000 – 1400 cm^{-1}, depending on the diameter) in the mid-IR that is not present in bulk bismuth. The full width at half maximum intensity of the IR absorption peaks decrease from 26 cm^{-1} at 300 K to 15 cm^{-1} at 77 K. No significant blue-shift in energy was observed, and these changes will be discussed in terms of the temperature dependence of the L-point and T-point electron energies.

Jason Reppert
Clemson University

Date submitted: 01 Dec 2008 Electronic form version 1.4