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Fermi surface studies of Ni nanowires through the proposed semimetal-to-semiconductor transition T.E. HUBER, Howard University, Washington, DC, A.A. NIKOLAEVA, Applied Physics.Kishinev,Moldova, M.J. GRAF, Department of Physics. Boston College. Chestnut Hill, MA — Theoretically, for Bi wire diameters near 60 nm (roughly the Fermi wavelength), quantum confinement effects cause Bi nanowires to undergo a semimetal-semiconductor transition involving modifications in the Fermi surface and band structure. Our recent measurements of the Fermi surface for 80-nm Bi nanowires show a dramatic decrease of the carrier density relative to that for the bulk, consistent with the model of quantum confinement, whereas for 30-nm nanowires we find significant discrepancies are found. Surface states, which have been observed via ARPES for surfaces of Bi crystals and via transport measurements on thin Bi films, may explain these discrepancies. We use a high-pressure, high-temperature injection technique with nanochannel dielectrics as a template structure to fabricate dense composites consisting of networks of trigonal-axis oriented bismuth nanowires. Electronic transport is studied over a wide range of temperatures down to low temperatures (0.3 K) and for magnetic fields up to 47 T. We focus on Shubnikov-de Haas oscillations of the magnetoresistance, which provide direct measurement of some cross-sectional areas of the carrier's Fermi surfaces and estimates for the carrier density, effective masses and relaxation times [Appl.Phys.Lett. 84, 1326 (2004)]. Supported by the Army Research Office, National Science Foundation, and CRDF.

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