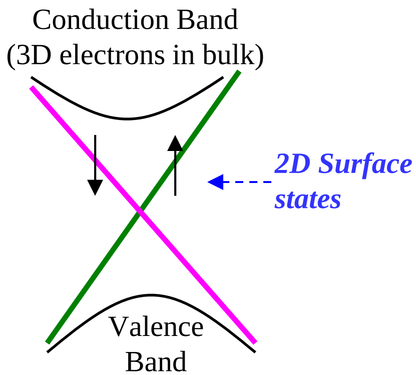
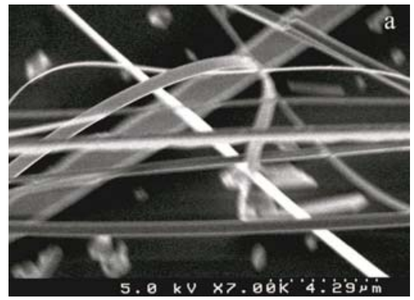
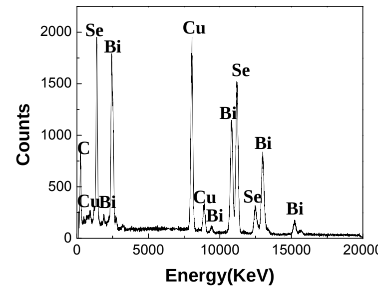
Nanowire Thermoelectrics for Energy Conversion

- Two-Dimensional Electron Transport in Bi_2Se_3 Nanoribbons

Xuan Gao, Department of Physics, Case Western Reserve University







Bi_2Se_3 and related materials have been the benchmark in thermoelectrics. Recent research showed that there are novel Dirac electrons residing on the surface of Bi_2Se_3 which is now part of the 'topological insulator' material family. These Dirac surface electrons might give rise to new electronic and thermoelectric properties. We used chemical vapor deposition to grow nanoribbons of Bi_2Se_3, with a goal to exploit the large surface-to-volume ratio of nanostructures. Scanning electron microscopy and energy dispersive X-ray spectroscopy studies showed high quality single crystal with correct stoichiometry (2: 3 atomic ratio for Bi and Se).

A key issue in the study of two-dimensional (2D) surface states in topological insulator is distinguishing the 2D surface conduction from 3D bulk conduction. We have investigated the magnetic field dependent electrical transport of Bi_2Se_3 nanoribbons. A quasi-linear field dependent resistance increase is discovered in the perpendicular field orientation and is shown to be originated from purely 2D transport by rotating the sample in magnetic field. This 2D electron transport induced linear magneto-resistance is found to be robust at all temperatures (2-300K), suggesting the potential of using 2D topological surface conduction in magneto-electronics or thermoelectrics at practical temperatures.