Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Hybrid Physical-Chemical Vapor Deposition of Bi_2Se_3 Thin films on Sapphire JOSEPH BROM, YUE KE, RENZHONG DU, JAROD GAGNON, QI LI, JOAN REDWING, The Pennsylvania State University — High quality thin films of topological insulators continue to garner much interest. We report on the growth of highly-oriented thin films of Bi_2Se_3 on c-plane sapphire using hybrid physical-chemical vapor deposition (HPCVD). The HPCVD process utilizes the thermal decomposition of trimethyl bismuth (TMBi) and evaporation of elemental selenium in a hydrogen ambient to deposit Bi_2Se_3. Growth parameters including TMBi flow rate and decomposition temperature and selenium evaporation temperature were optimized, effectively changing the Bi:Se ratio, to produce high quality films. Glancing angle x- ray diffraction measurements revealed that the films were c-axis oriented on sapphire. Trigonal crystal planes were observed in atomic force microscopy images with an RMS surface roughness of 1.24 nm over an area of 2μmx2μm. Variable temperature Hall effect measurements were also carried out on films that were nominally 50-70 nm thick. Over the temperature range from 300K down to 4.2K, the carrier concentration remained constant at approximately $6x10^{18}cm^{-3}$ while the mobility increased from 480 cm^2/Vs to 900 cm^2/Vs. These results demonstrate that the HPCVD technique can be used to deposit Bi_2Se_3 films with structural and electrical properties comparable to films produced by molecular beam epitaxy.

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Date submitted: 11 Nov 2011 Electronic form version 1.4