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The Effects of Different Ambient Environments on the Electrical Properties of Bi_2Se_3 Thin Films over Time JOSEPH BROM, The Pennsylvania State University, MALIA KAWAMURA, Colby College, JOAN REDWING, The Pennsylvania State University — It has been recognized recently that the Bi_2Se_3 surface is highly susceptible to environmental doping at room temperature when exposed to ambient air. The change in conductivity is correlated to oxidation of the surface; however, the roles of O_2 and residual H_2O in the process are not fully understood. In this study, we investigated the effects of different ambient environments (air, O_2, N_2, H_2O) on the electrical properties of Bi_2Se_3 thin films grown by hybrid physical-chemical vapor deposition. Hall measurements were performed on samples exposed to each of the gases over a period of several hours to days. The electron concentration of the Bi_2Se_3 films initially decreased upon exposure to air but began to rapidly increase and continued to do so over the next several hours. The use of an O_2 purge resulted in a large initial decrease in electron concentration suggesting that O_2 rapidly diffuses into Bi_2Se_3 and partially compensates the native donors. Over time, however, the electron concentration began to rise rapidly in a similar manner to that observed in air. Exposure of the surface to water vapor resulted in nearly identical behavior to that obtained in air. In contrast, measurements carried out under a N_2 purge demonstrate a small initial decrease in electron concentration but do not exhibit an appreciable increase in electron concentration even after 24 hours. The mechanism of surface oxidation and conductivity change will be discussed.

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