Room-Temperature Ferromagnetic Property in MnTe Semiconductor Thin Film Grown by Molecular Beam Epitaxy

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MnTe layers of high crystalline quality were successfully grown on Si(111) and Al_2O_3 (0001) substrates by molecular beam epitaxy. We have investigated the structure, magnetic and electric transport properties of MnTe layers by using X-ray diffraction (XRD), superconducting quantum interference device (SQUID) magnetometer, physical properties measurement system (PPMS), and X-ray photoelectron spectroscopy (XPS). Characterization of MnTe layers on Si(111) and Al_2O_3 (0001) substrates by X-ray diffraction (XRD) revealed a hexagonal structure of polycrystalline growth for MnTe/Si(111) and epitaxial growth for MnTe/Al_2O_3 (0001), respectively. Investigation of magnetic properties for MnTe layers showed ferromagnetic properties above room temperature unlike antiferromagnetic bulk MnTe materials. The great irreversibility between zero-field-cooling and field-cooling magnetization were observed. Apparent ferromagnetic hysteresis loops are measured at room temperature. In electro-transport measurements, the temperature dependence of resistivity revealed a noticeable semiconducting behaviors and showed a conduction via variable range hopping (VRH) at low temperature. From XPS results, we assume that the origin of ferromagnetism in samples may be due to the breaking of superexchange antiferromagnetic correlations between Mn spin moments arising from Tellurium vacancies.

***Index Terms*—Magnetic semiconductor, molecular beam epitaxy, NiAs-type MnTe, X-ray photoelectron spectroscopy.**