

Effects of Cr Doping on the Electronic Structure of MnTe

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The effects of Cr doping on the electronic structure of semiconducting MnTe have been investigated by using electron and optical spectroscopies. All $\text{Cr}_x\text{Mn}_{1-x}\text{Te}$ samples grown as polycrystalline films by molecular beam epitaxy on Si(100) substrates showed a NiAs structure with little change in lattice parameters for $x \leq 0.15$. X-ray photoelectron spectroscopy and spectroscopic ellipsometry results suggest the existence of spin-polarized Mn d bands in $\text{Cr}_x\text{Mn}_{1-x}\text{Te}$. The majority- and the minority-spin d bands are likely to be located ~ 4 eV below and ~ 3 eV above the Fermi level, respectively. The direct optical-band-gap of $\text{Cr}_x\text{Mn}_{1-x}\text{Te}$ is found to gradually decrease with increasing x in the infrared region. A ferromagnetic behavior was observed for the $\text{Cr}_x\text{Mn}_{1-x}\text{Te}$ films. The possible origin for the ferromagnetism is the coupling of Cr spins mediated by spin-polarized holes in the valence bands created through the hybridization between Te p and Cr d states.