

Observation of "magnetic freeze-out" phenomenon: study of magnetoresistance of $\text{Fe}_{1.5}\text{Ti}_{0.5}\text{O}_{3-\delta}$ magnetic oxide semiconductor

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On the goal of an alternative way to realize an above 300K ferromagnetic semiconductor for intrinsic spin injection, the solid solution hematite-ilmenite $\text{Fe}_{2-x}\text{Ti}_x\text{O}_3$ appeared to be a good candidate: Curie temperature $T_C > 400$ K, intrinsically conductive due to $\text{Fe}^{3+}/\text{Fe}^{2+}$ mixed valences [1-3]. In the presented work, we study in details the conductivity mechanism and magneto-transport electronic properties of $\text{Fe}_{1.5}\text{Ti}_{0.5}\text{O}_{3-\delta}$ thin films deposited by PLD on $\text{Al}_2\text{O}_3(0001)$ substrates, in the 100K-500K range with magnetic fields (Hall and planar hall configuration) up to 9T. The zero-field transport properties are governed by the oxygen stoichiometry with a dominant Near Neighbor Hopping mechanism with activation energy around 100 meV. Magnetoresistance versus temperature dependence presents "magnetic freeze out" phenomenon, it also changes sign and has different behavior depending on the magnetic field orientation. Optical properties in visible and NIR region has been studied as well.

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