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MBE-growth and Oxygen Pressure Dependent Electrical and Magnetic Properties of Fe3O4 Thin Films

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Giant magnetoresistance (GMR), tunneling magnetoresistance (TMR), and magnetic random-access memory (MRAM) are currently active research areas in spintronics. The high magnetoresistance and the high spin polarization (P) of electrons in the ferromagnetic electrodes of tunnel junction or intermediate layers are required. Magnetite, Fe3O4, is predicted to possess as half-metallic nature, P ~ 100% spin polarization, and has a high Curie temperature (TC～850 K). Experiments demonstrated that the P～(80 ± 5)%,～(60 ± 5)%, and ～40-55% for epitaxial (111), (110) and (001)-oriented Fe3O4 thin films, respectively. Epitaxial Fe3O4 films may enable us to investigate the effects of half metals on the spin transport without grain-boundary scattering.In addition, it has been reported that the Verwey transition (TV, a first order metal-insulator transition) of 120 K in bulk Fe3O4 is strongly affected by many parameters such as stoichiometry and stress, etc.

Here we report that the growth modes, magnetism and transport properties of Fe3O4 thin films were strongly dependent on the oxygen pressure during film growth. The average roughness decreases from 1.021 to 0.263 nm for the oxygen pressure increase from 2.3×10-7 to 8.2×10-6 Torr, respectively. The 120 K Verwey transition in Fe3O4 was disappeared for the sample grown under high oxygen pressure.

Keywords: Fe3O4, MBE, Thin film