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STRUCTURAL AND MAGNETIC PROPERTIES IN IRON OXIDE EPITAXIAL THIN FILMS

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Magnetite Fe_3O_4 has been known to be a fundamental spinel ferrite ubiquitously found in nature as a component of iron sand. It also has a magnetization of 6kG which is high among ferrites, a high Curie temperature of 858K and the intriguing electronic physical properties of half-metallicity and large anomalous and planar Hall effect, leading to the possibilities of various spintronic memory and sensor devices. Sputtered Fe_3O_4 thin films epitaxially grown on heated MgO(100) and other cubic single-crystalline substrates were evaluated by high-resolution XRD, magnetization measurements using VSM and SQUID, temperature dependence of resistivity by PPMS, and hyperfine structures by conversion electron Mössbauer spectroscopy, CEMS. In-plane and out-of-plane structural characterization revealed that the samples were composed of a single phase of spinel structure, the cube-on-cube epitaxial relationship between the Fe_3O_4 layer and substrate crystals and low FWHM of rocking curves in a range of several tens to several hundred arcsec. The magnetization was found to reach 6kG of the reported bulk value. The Verwey transition around 120K, of which observation is usually difficult in thin film form, was clearly confirmed from resistivity measurements. The CEMS showed that the vacancy parameters delta depends on gas pressure during sputter deposition and strongly influence the structural and magnetic properties. Epitaxial growth of another attractive ferromagnetic iron oxide of metastable epsilon-Fe_2O_3 will be briefly presented.

BIOGRAPHY

Masato Watanabe has earned his PhD from Tohoku University in Japan. He is currently Chief Research Scientist of Research Institute for Electromagnetic Materials, a public utility foundation in Sendai Japan. He has been involved in research subjects mainly on magnetic functionalities including hard magnetism, magnetooptical properties and anomalous hall effect in inorganic sputtered thin films and laser-generated nanoparticle colloids belonging to the foundation, universities and private companies.

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