M Kotsugi et al., J Material Sci Eng 2017, 6:4(Suppl)
DOI: 10.4172/2169-0022-C1-067

Rare-metal-free super magnet $L1_0$-type FeNi ordered alloy

M Kotsugi, J Ochiai, M Tomita, Y Suzuki, M Saitoh and AMori
Tokyo University of Science, Japan

For the realization of low carbon society, development of advanced magnetic materials has been rapidly progressed in this decade. Especially, rare-metal-free-super magnet is key material of electric vehicles and renewable energy, to increase conversion efficiency and reduce environmental load. $L1_0$-type FeNi(Co) order alloy is a candidate of such advanced magnetic material. $L1_0$-FeNi is described as an ordered alloy, in which Fe and Ni single atomic layers are alternately stacked along the c-axis direction. Its predicted magnetic anisotropy energy is 1×10^7 erg/cc and magnetic moment is 1200 emu/cc. Magnetic anisotropy is known to correlate strongly with lattice structure and electronic structure. However, the study of local magnetic moment and surface morphology has not been satisfactorily carried out so far. In this work, we report: (1) the construction of pulsed-laser-deposition (PLD) system, (2) fabrication of $L1_0$-FeNi(Co) by alternate monoatomic layer deposition and (3) macroscopic and microscopic characterization of $L1_0$-FeNi(Co) thin film. We examine the perpendicular magnetization by using super quantum interference device (SQUID) and photoemission electron microscope (PEEM). Magnetization curve was measured using SQUID. Result of SQUID shows that saturation magnetization (Ms) of 265 emu/cc, out-of-plane magnetization is greater than in-plane magnetization therefore; easy axis of magnetization is out-of-plane. Magnetic domain observation was carried out by photoelectron emission microscope utilizing X-ray magnetic circular dichroism (XMCD-PEEM) at soft X-ray undulator beamline BL17SU of SPring-8. Results of XMCD shows maze-pattern was confirmed. This behavior is clearly different from magnetic domain with B2-FeCo with in-plane magnetization. We suggest that FeCo film obtains perpendicular magnetization with spontaneous magnetization.

Biography

M Kotsugi has his expertise in surface and interface magnetism based on molecular beam epitaxy and synchrotron radiation. He received his PhD based on surface electron diffraction thesis from Osaka University. He joined Max Planck Institute in 2001 as a Post-doctorate, where he worked in the field of Multilayer Magnetism. He is currently heading the Electronic Solid State Engineering Laboratory in Tokyo University of Science.

kotsugi@rs.tus.ac.jp

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