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A Study on the Magnetic Properties of Ion Irradiated Cu/Co Multilayer System

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In this research, we used the ion irradiation technique which has an advantage in improving intentionally the properties of surface and interface in a non-equilibrium, instead of the conventional annealing method which has been known to improve the material properties in the equilibrium state. Cu/Co multilayered films were prepared on $SiN_4/SiO_2/Si$ substrates by the electron-beam evaporation for the Co layers and the thermal evaporation for the Cu layers in a high vacuum. The ion irradiation with a 80 keV Ar^+ was carried out at various ion doses in a high vacuum.

Hysteresis loops of the films were investigated by magneto-optical polar Kerr spectroscopy at various experimental conditions. The change of atomic structure of the films before and after the ion irradiation was studied by glancing angle x-ray diffraction, and the intermixing between Co and Cu sublayers was confirmed by Rutherford backscattering spectroscopy. The surface roughness and magneto-resistance were measured by atomic force microscopy and with a four-point probe system, respectively. During the magneto-resistance measurement, we changed temperature and the direction of magnetization.

From the results of experiments, we found that the change at the interfaces of the Cu/Co multilayered film induced by ion irradiation cause the change of magnetic properties. According to the change in hysteresis loop, the surface inplane component of magnetic easy axis was isotropic before the ion irradiation, but became anisotropic upon irradiation. It was confirmed that this change influences the axial behavior of magneto-resistance. Especially, the magneto-resistance varied in accordance with an external magnetic field and the direction of current, which means that magneto-resistance also shows the uniaxial behavior.