フレキシブル基板上の Ni 薄膜における応力誘起巨大磁気異方性変化

Stress-induced giant modulation of magnetic anisotropy in Ni thin films deposited on a flexible substrate

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Stress-induced magnetic anisotropy modulation has been studied using various systems. A ferromagnetic film deposited on a flexible substrate is one of the systems that can easily obtain large strain by stress application. In this work, we realize 90° switching of in-plane magnetic easy axis by applying a tensile stress to Ni thin films deposited on polyethylene naphthalete (PEN) substrate. The change is completely reversible and a large difference in the saturation magnetic field ($\mu_0 H_s$) up to ~0.3 T, which corresponds to a change in the magnetic anisotropy energy of ~7×10^4 J/m^3, is realized at the 2.3% of strain.

Samples composed of Ta(3 nm)/Ni(t_{Ni} nm)/Ta(4 nm) tri-layer were deposited on PEN substrate by RF sputtering at room temperature and fabricated into the wire structure with voltage probes. Magnetization measurement and the anisotropic magnetoresistance (AMR) effect was used to detect the magnetization direction. The uniaxial stress was applied to the film by stretching the substrate parallel to the longitudinal direction of wire (*x*-direction) using the tensile machine [1]. Figure 1 shows the normalized magnetization curves for the strain values (ε) of 0 and 2.3%. Magnetic field was swept in *x* direction. The initial magnetic easy axis for ε = 0% is *x* direction, whereas the curve for ε = 2.3%, which was reproduced from the result of AMR curve, shows that *x* direction is the hard axis. The result clearly indicates that the switching of magnetic easy axis from *x* to *y* is achieved. The magnitude of $\mu_0 H_s$ change reaches ~0.3 T at ε = 2.3%. This change is an order of magnitude larger than that in the previous reports [2], and is, in fact, comparable to that in giant magnetostrictive materials [3].

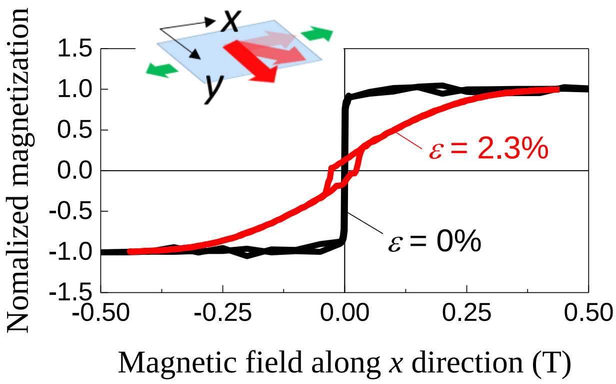

Figure 1: The normalized magnetization curves under ε of 0 and 2.3%.

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