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In-situ Stress and Magnetoelastic Coupling Study of Co/Pd Nanomultilayer Films

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Recent studies on magnetoelastic coupling (MEC) of ultrathin films show that MEC of ultrathin films is drastically changed at the film interface compared to the bulk one. Thus, in addition to the bulk MEC, interface alloy formation or existence of strain due to the lattice msimatch at interface are generally introduced to explain the behavior of MEC near the film interface or surface.[1,2] However, it is still unclear that which mechanism plays a key role in MEC of ultrathin ferromagnetic films. In this study, we have investigated layer-by-layer evolution of the MEC constant for Co/Pd nanomultilayer films to understand the variation of the MEC constant at the Co/Pd interface. The MEC constant and growth stress were measured by submonolayer-resolution in situ stress/MEC measurement system in an UHV chamber equipped with SMOKE, RHEED, and STM. In situ stress measurement for the (6- Co/20-Pd)6 nanomultilayer revealed that tensile stress was developed at the 1st and 2nd Pd sublayer deposition and it continuously changed to compressive stress after the 3rd Pd sublayer deposition. We measured the evolution of the MEC constant in the 2nd (tensile-stress region) and the 6th (compressive-stress region) Pd sublayer with varying the Pd thickness. It was found that the evolutions of the MEC constant in the 2nd and the 6th sublayers were completely different. To understand the different evolutions of MEC constant in the 2nd and the 6th Pd layer, we adopted the phenomenologocal model considering interface contribution and strain correction. We found that the evolution of MEC constant at interface is intimately related with intrinsic stress rather than interface formation and second-order strain correction is crucial to describe the dependence of MEC on the film strain. This work was supported by the Korean Ministry of Science and Technology through the Creative Research Initiatives Project.

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[2] J.-R. Jeong and S.-C. Shin, Appl. Phys. Lett. 79, (2001) 329.