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X-ray Reflectivity Study on [FeCo/Pd]$_n$ Super-Lattice films

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Introduction

In recent years, a density of magnetic recording is continuously increasing by introducing new materials. Recently, we developed the [FeCo/Pd]$_n$ super-lattice films for the main pole material in a writing head that shows a saturation magnetization (Bs) of 2.6T, which is higher than the standard FeCo alloy of 2.4T, suitable for the high density recording. The increase of Bs may be related to the induced magnetism at the Pd interface. X-ray reflectivity can provide a information on roughness at the layer interfaces in addition to the depth distribution of mass density. To determine these parameters for the high Bs samples, we performed the X-ray reflectivity measurement at beamline 18B.

Experimental

Sample preparation

The [FeCo/Pd]n super-lattice samples were deposited in a magnetron sputtering at room temperature on a Si wafer with a Cr(50Å) buffer layer. On top of the layers, a Ru(35Å) layer was formed to prevent the oxidation of the internal multilayer. The composition of the FeCo layer is Fe 70% and Co 30%. To compare the depth profile of these structure, the following two samples with a different Pd thickness, A:[FeCo(17Å)/Pd(1Å)]$_{25}$, B:[FeCo(17Å)/Pd(2Å)]$_{25}$ were prepared. The number after the angle bracket indicates the repetition of the layer. The total thicknesses of the samples were around 500 Å.

Reflectivity measurement

The X-ray reflectivity measurements were done at the beamline 18B in the Photon Factory with a X-ray wavelength of 1.4 Å. Figure 1 shows the reflected intensity profile for sample A and B where the Bragg peaks from the super-lattice are clearly seen. In the figure, the solid line indicates the simulated result from the layered model where the reflected intensity are calculated from the layer thickness, mass density as shown in figure 2, and interface roughness, whose values are optimized to reproduce the measured data.

As shown in these figures, we successfully reproduced the measured data and evaluated the interface roughness and the mass density profile on [FeCo/Pd]n super-lattice samples in which the thickness of Pd layer of sample A and B are only 1 and 2 Å, respectively.

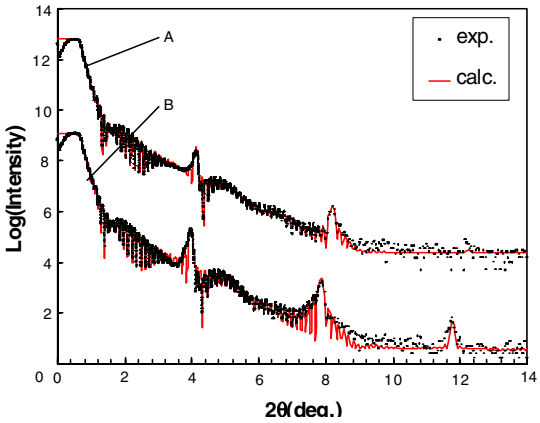

Figure 1. Measured (dot) and calculated (line) X-ray reflection intensity for sample A and B.

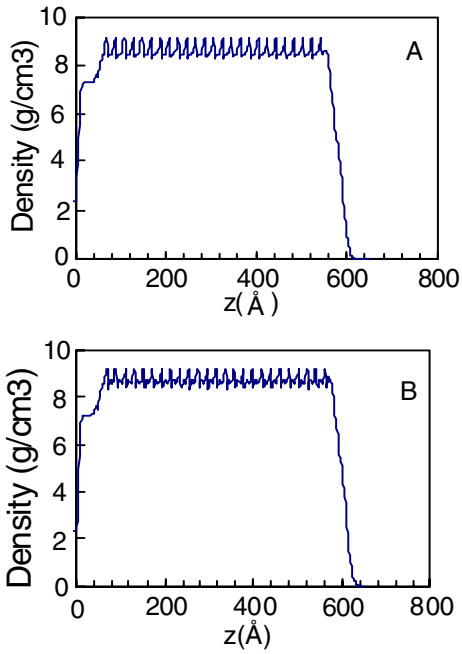

Figure 2. Calculated mass density profile for sample A and B.

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