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# EXAFS study for FePt thin films with annealing temperature.

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## 1. Introduction

FePt alloy film with an ordered fct structure have received significant attention due to their attractive magnetic properties such as a high magnetic crystalline anisotropy and a high coercivity, making them useful as an ultrahigh density magnetic recording media. Advanced magnetic properties of FePt film are obtained by high degree of chemical order. The structural properties of FePt thin films have been manystudied by means of XRD and TEM analysis. Typically, both analyses inform the degree of ordering means by macroscopic crystalline phase. In addition to both analyses, local atomic ordering study will be given an useful information to understand the structural phase variation in the FePt alloy film. Extended x-ray absorption fine structure(EXAFS) technique has examined the local structure and ordering around a concerned atoms in crystalline or amorphous. In this study, the local structural ordering of FePt alloy films has been investigated as a function of annealing temperature. The local structural evolution of FePt alloy film will be discussed by EXAFS analysis with annealing temperature.

## 2. Experimental

Multilayer structure of $[Fe(2.5\ nm)/Pt(2.5\ nm)]_{20}$ films were grown by magnetron sputtering with pure Fe and Pt targetat room temperature. The alternate Fe and Pt layers were deposited on Pt(5 nm) buffer and the top of films were capped by Pt(5 nm) to prevent oxidation. The substrate was adopted as a polished pused silica in order to prevent appearance of diffraction peak from EXAFS spectra. The Fe/Pt multilayer films were annealed in order to induce the ordered structure with vacuum atmospher during an hour. The annealing temperature($T_a$) was varied from 0 to 700 °C. The local structural change for the prepared samples was examined by using EXAFS spectroscopy. EXAFS experiments were carried out at the beam line 3C1 EXAFS of the Pohang Light Source (PLS) in the Pohang Acceleratory Laboratory (PAL) in Korea. The EXAFS spectrum was measured near the Fe (7112 eV) K-edges by fluorescence method.

## 3. Results and discussion

The local structure and the atomic ordering were examined by using EXAFS experiment. The radial atomic density in real space can be seen in the Fourier transformed spectrum. Fig. 1 shows the Fourier transform of EXAFS spectra for Fe/Pt multilayer films with annealing temperature, which measured at Fe K-edge. The vertical dashed line indicates the location of Fe first shell. The Fe film means the pure Fe(300 nm) thin film which inserted to comparison. The spectrum

of as-deposited sample is similar to Fe film except to a lower intensity. It implies that the atomic distribution and ordering around Fe atoms aresame to that of pure Fe structure. The Fe structure of Fe/Pt multilayer film was maintained up to $T_a$ = 300 °C as shown in Fig. 1. However, the shape of first shell is changed and the long range ordering is also obviously changed from $T_a$ = 350 °C. The peak at R=2.7Å is the contribution of Pt atoms in the first nearest neighbors around the Fe atoms. The change of first shell peak shape represents the variationof local structure around the Fe atoms due to interfacial diffusion between Fe and Pt layers. Furthermore, the clear change of the long range ordering around Fe atoms is the direct evidence of the FePt alloy formation corresponding to the ordered phase formation. From Fourier transformed spectrum, the atomic distance was analysised. According to analysis, the atomic distance between Fe and Fe atoms was steeply increase and also the atomic ordering of Fe and Pt was appeared at the annealing temperature of 350 °C. The structural phase transformation of Fe/Pt multilayer film gives rise to the increase of atomic distance for the Fe-Fe and the Fe-Pt.

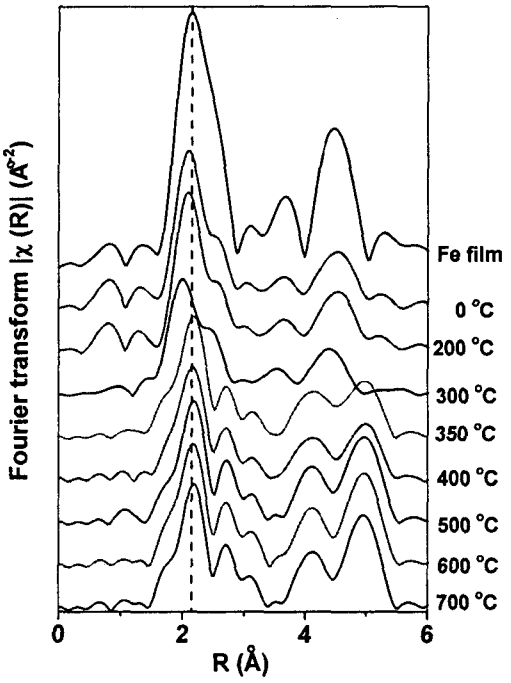


Fig. 1. Fourier-transformed EXAFS spectra for Ta(5)/[Fe(2.5)/Pt(2.5)]$_{20}$/Pt(5nm) thin films measured at the Fe K-edge with annealing temperature. The vertical dashed line indicates the location of the Fe first shell. Fe film means the pure Fe(300nm) thin film.