P-4

# THE MAGNETIC PROPERTIES AND CORROSION RESISTANCE OF Fe-Ti-N THIN FILMS

Hanyang University H.W.Choi*, J.H.Jeong, K.H.Kim, J.Kim
KIST S.H.Han, H.J.Kim

# Fe-Ti-N 박막의 자기적특성 및 부식저항에 관한 연구

한양대학교 최현우*, 정주현, 김기현, 김종렬
한국과학기술연구원 한석희, 김희중

## 1. INTRODUCTION

FeN-based soft magnetic materials have been studied for writing head materials. To write data on high coercivity media, high saturation magnetization and good soft magnetic properties are required for inductive write head materials. In addition to magnetic properties, good reliable performance such as corrosion resistance and thermal stability are desired for facilitating head fabrication.

In this work, FeN-based soft magnetic thin films such as Fe-Hf-N, Fe-Ti-N, Fe-Ta-N and Fe-Al-N, have been investigated to enhance the saturation magnetization without the loss of soft magnetic properties [1][2]. The corrosion resistance and the magnetic properties of as-sputtered Fe-Ti-N thin films, shown excellent magnetic properties with high saturation magnetization, have been also investigated [3].

## 2. EXPERIMENT

Fe-N based thin films were prepared by a reactive rf magnetron sputtering method using composite target. The partial pressure $P_{N2}$ was controlled in the range of 0~15% keeping the total gas ($Ar+N_2$) pressure of 1 mTorr. The films with 1μm thickness were deposited on Si(100) substrate. The composition of the films was analyzed by auger electron spectroscopy (AES) and Rutherford backscattering spectroscopy (RBS). The magnetic properties of the films were measured by vibration sample magnetometer (VSM). Using a B-H loop tracer, magnetic anisotropy direction of the films was characterized. The frequency dependence of effective permeability ($\mu_{eff}$) was measured by using an 8-figure coil method. The electrical resistivity of the films was measured by a four-point probe method. The microstructure was investigated by transmission electron microscopy (TEM) and x-ray diffraction (XRD) with $CuK_{\alpha}$. Electrochemical corrosion data were obtained using an EG&G Par 273A electrochemical test system.

## 3. RESULTS AND DISCUSSION

The saturation magnetization ($4\pi M_s$) and $\mu_{eff}$ of Fe-Ti-N thin films vary with the nitrogen partial pressure as shown in Fig.1. The $4\pi M_s$ linearly decreases with an increment of the nitrogen partial pressure. In case of low nitrogen partial pressure, the saturation magnetization shows about 20.2 kG such as pure Fe films. The $\mu_{eff}$ of the films gradually increase with the increment of $P_{N2}$ from 1 % to 4 % and reach about 2000 at 100 MHz. However, the further increment of

$P_{N2}$ deteriorates the $\mu_{eff}$.

Fig.2 shows the anodic polarization curves for Fe-Ti-N films with comparison to pure Fe and Permalloy films. The corrosion resistances of Fe-Ti-N films increase with the increment of $P_{N2}$. Though the corrosion resistance of the FeTiN films improves like the Permalloy film over $P_{N2}$ = 8 %, soft magnetic properties are extremely deteriorated.

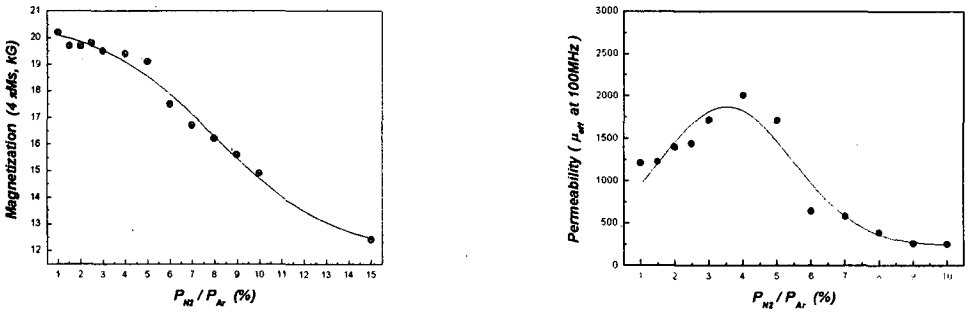


**Fig.1 Variations of Saturation magnetization and Permeability for the FeTiN films with an increase of $N_2$ partial pressure.**

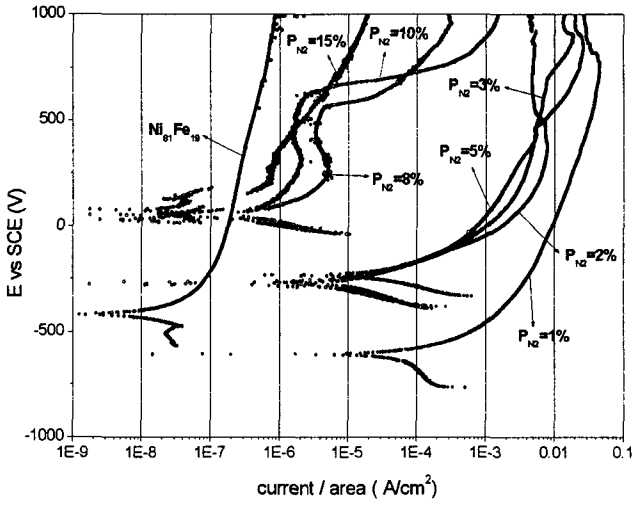


**Fig.2 Comparison of the Anodic polarization curves of Fe-Ti-N films.**

## 4. REFERENCES


[1] G. Qiu, E. Haftek, and J. A. Barnard, J. Appl. Phys. 73, 6573(1993)

[2] J. Y. Song, J. J. Lee, S. H. Han, H. J. Kim and J.Kim, J. Appl. Phys. 83, 6652(1998)

[3] H. Y. Wang, Y.J. He, Z. W. Ma, E. Y . Jiang, H. S. Huang and W. H. Mao, J. Appl. Phys. 85, 3745(1999)