

## SOFT MAGNETIC PROPERTIES OF CoFeZrO THIN FILMS

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We have investigated magnetic and electrical properties of CoFeZrO thin films, deposition on silicon (100) substrate by radio frequency reactive magnetron sputtering in an O<sub>2</sub>/Ar atmosphere using composite target, which was composed from Co<sub>30</sub>Fe<sub>70</sub> (99.95%) of 10 cm, 3 mm in diameter and thickness, respectively, and N (N = 4, 6, 8, 12) Zr chips placed on it by coaxial circle of the target and a diameter of the chip's circle of 4

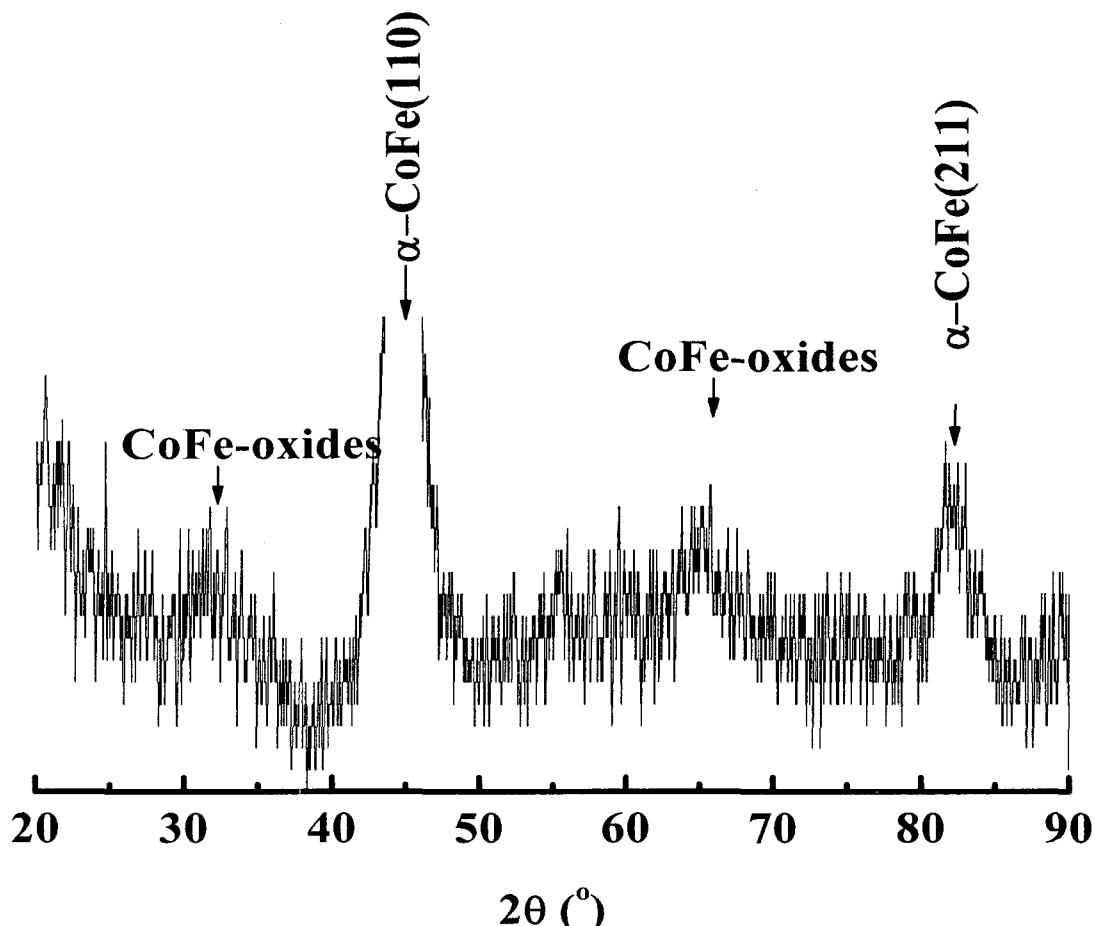
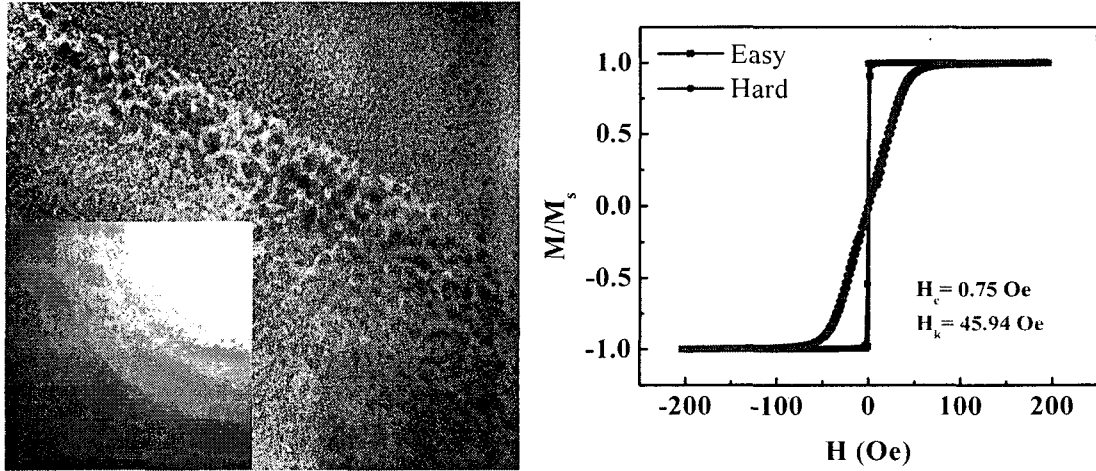


Figure 1. X-ray diffraction pattern of CoFeZrO thin film fabricated at 300W, 2 mTorr, 8 Zr chips and partial pressure of oxygen of 5%.

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cm. The base pressure is less than  $2 \times 10^{-7}$  Torr. The deposition condition was carried out with sputtering power varying in the range of 200-300W, under atmosphere pressure of  $2 \times 10^{-3}$  Torr. An external magnetic field of about 100 Oe was also applied to the films plane during deposition.

The composition and microstructure of the films were controlled by varying partial pressure of oxygen and number of Zr chips placed on the  $\text{Co}_{30}\text{Fe}_{30}$  target. The films thickness were controlled in the range of 500-600 nm and measured by Tenco 500 profilometer. The magnetic properties, electrical resistivity, high frequency characteristics were measured using vibrating sample magnetometer, four points. The microstructure of the film samples was checked by x-ray diffraction (XRD) and observed by transmission electron microscope (TEM). The composition of the films was determined by Auger electron spectra (AES). The high frequency effective permeability of the films was measured from 1 MHz to 3000 MHz along the hard axis of the films under dc bias field of 10 Oe using a HP8752C network analyzer.

Figures (1, 2, 3) show x-ray diffraction patterns, TEM and hysteresis loops of the CoFeZrO thin films fabricated at 300W, partial pressure of oxygen of 5%, 2 mTorr, and 8 Zr chips, respectively. The CoFeZrO thin films exhibit good soft magnetic properties ( $H_c = 0.3$  Oe,  $4\pi M = 19.7$  kG), high electrical resistivity of  $627.3 \mu\Omega\text{cm}$ , strongly anisotropy magnetic field of 47.52 Oe. The films also have very good high frequency characteristics,  $f_{FRM}$  over 3 GHz. It is also found that the soft magnetic properties, electrical resistivity and high frequency characteristics of the films have a strong dependence on the microstructure of nanogranular shape and size.