Crystallographic and Magnetic Properties of $CoAl_{0.2}Fe_{1.8}O_4$ Thin Films Prepared by a Sol-Gel Method

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***Abstract*—Thin films of Al-substituted cobalt ferrite layers on thermally oxidized silicon wafers were fabricated via the sol-gel method with various annealing temperatures. Structural and magnetic properties of the films were investigated with thermogravimetric and differential thermal analysis (TG-DTA), an x-ray diffractometer, vibrating sample magnetometer (VSM), and atomic force microscopy (AFM). TG-DTA measurements showed exothermic reaction peak at 285°C. $CoAl_{0.2}Fe_{1.8}O_4$ thin films that fired at and above 400°C had a single cubic spinel structure without any preferred crystallite orientation. Lattice constants monotonically decreased from 0.8381 to 0.8354 nm with increasing annealing temperature from 400 to 800°C. As annealing temperature increased from 400 up to 800°C, grain size increased from 4.6 to 25.4 nm, whereas the surface roughness was minimized at 700°C with a value of 2.0 nm. Parallel and perpendicular coercivity at room temperature showed maximum values of 1980 and 2490 Oe, respectively, in the sample annealed at 700°C. Coercivity was shown to be strongly dependent not only on annealing temperature but also on surface roughness.**

***Index Terms*—Atomic force microscopy, Co ferrite, coercivity, sol-gel method, thin film, vibrating sample magnetometer.**