

Absolute Thickness Determination of SmCo Films on Silicon Substrates
Utilizing X-ray Diffraction and Their Composition Measurements by
EXRF

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This paper presents a measurement technique for accurate determination of thickness and composition of SmCo magnetic films deposited on single crystal Silicon (100) substrates by sputtering. X-Ray diffraction of monochromatic Cu $K\alpha_1$ line has been used to measure the intensity of the (400) reflection from bare silicon substrates and as attenuated by sputter coated SmCo based films on Si substrates. A 4-axis research diffractometer allowed the substrate orientation to be fine adjusted to maximize the (400) diffraction intensity. The absolute thickness of SmCo based films was in a range from 0.05 to 5 μm . In addition, the fluorescence of Sm $K\alpha$, Fe $K\alpha$, Co $K\alpha$ count rates were measured by a Peltier cooled x-ray detector. A method of analysis was developed and computer programs were written to calculate thickness and concentration of these elements and their stoichiometry in films. Accuracy, detection limits, mass absorption effects and sensitivity are discussed. This approach can be useful not only for magnetic film measurements but also in quantitative analysis of pigments in art painting, in nanotechnology and could be incorporated into modern XRD/XRF equipment.