The influence of deposition temperature on the structure, microstructure, morphology and magnetic properties of sputter deposited nickel thin films

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The influence of deposition temperature on the structure, microstructure, morphology and magnetic properties of sputter deposited Nickel thin films

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Abstract

This paper reports the evolution of microstructure and texture and their correlation with the magnetic properties of Nickel thin films fabricated by direct current (DC) magnetron sputtering on a Silicon (100) substrate kept at different temperatures. The structural and microstructural investigations employing an X-ray diffraction line profile analysis (XRD-LPA) revealed an increase in the grain size and a significant reduction in the dislocation density by increasing the substrate temperature. The crystallographic texture of the films was characterized by a preferred (111) orientation in the films, irrespective of the deposition temperature. However, the evolution of a recrystallization cube texture (100) <001> was also observed with an increase in the deposition temperature in the films. The microstructure of the films deposited at room temperature showed a columnar growth morphology along the cross-section. The development of an equi-axed microstructure at higher temperatures was attributed to a higher mobility, enhanced surface and the bulk diffusion of ad-atoms arriving on the surface. A transition from soft to a hard magnetic character has been observed with an increase in deposition temperature. The magnetic force microscopy (MFM) revealed the presence of strip domains in the films deposited at room temperature. The presence of closure domains with disordered strip domains in the films deposited at 600 °C was correlated with