MAGNETIC PROPERTIES OF NANOCRYSTALLINE FENIN THIN FILMS

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Magnetic materials for high frequency applications must exhibit a combination of high saturation magnetization, low coercitivity and high permeability at high frequency as well as a satisfactory thermal stability and good resistance corrosion. It is well known that iron nitride thin films can present lower coercitivity, higher saturation magnetization and better resistance to corrosion if comparing with pure iron. Moreover, to improve both thermal stability and soft magnetic properties of these films a third element should be incorporated. In its turn, Ni is a good candidate because it also allows to reach a higher concentration of the third element in the Fe-X-N system with a good combination of magnetic properties. The aim of this work is to explore the effect of nickel and nitrogen concentration on the magnetic and microstructural properties of FeNiN thin films.
Nanocrystalline FeNiN films with Ni contents below 35 at % have been deposited on Si (100) substrates at temperatures between 10 and 300ºC using a dual ion beam sputtering system. The films were obtained by sputtering a Fe target with Ni chips on its surface and simultaneous bombardment with a controlled mixture of low energy argon and nitrogen ions. The composition of the FeNiN was adjusted by varying the amount of Ni mounted on iron target and the amount of nitrogen ions in the assistance beam. Film thickness was about 60nm as measured by a quartz crystal monitor during the deposition process. The chemical characterization of the films was performed by AES and XPS. The structure and crystalline size was determined by XRD. The magnetic properties have been investigated by using vectorial Kerr magnetometry. Room temperature angular dependence hysteresis loops have been used to determine the magnetic anisotropy and the magnetization reversal process of the films.
In general, in-plane uniaxial magnetic anisotropy and soft magnetic behavior for low Ni and N concentration (< 15 %at.) have been found in nanocrystalline FeNiN grown at temperatures < 150ºC. Nonetheless, coercitivity and remanence have been found to be related to Ni and N content in nanocrystalline FeNiN thin films, as well as to structural changes induced by the substrate temperature during deposition.