TF8.4.P

ELECTRODEPOSITED Ni-W MAGNETIC THIN FILMS WITH COLUMNAR NANOCRYSTALLITES

N. Sulitanu, F. Brînză
Department of Solid State Physics, Faculty of Physics, "Al.I.Cuza" University, Iaşi, Romania

Nanocrystalline Ni-W thin films (140 nm) containing from zero to 18 wt % W were electrolitically prepared and structural and magnetic characterized. XRD, SEM and TEM investigations have revealed that all segregated Ni columns are fcc-type whose [111] axis is oriented perpendicular to the film plane and have 140 nm in height and 6-27 nm in diameter. Depending on film composition, two types of nanostructures were observed: (a) single-phase nanostructure (< 7 wt % W) which consist of nanocrystalline Ni columns (d = 14-27 nm) separated by interfaces or "interphases", namely W enriched particles boundaries, and (b) two-phase nanostructure (7-18 wt %) in which a second Ni-W amorphous phase or even amorphous-disordered mixture separates the magnetic columnar Ni nanocrystallites (d = 6-14 nm). The <111> columnar crystallites have an easy magnetization direction along their long axis mainly due to the in-plane internal biaxial stresses. The saturation magnetization non-linearly decreased with small grain size. The variation of in-plane coercivity H_c of these phase-separated thin films is typical of single-domain Ni grains and reaches a maximum for 13 wt % W in composition. The magnetic properties strongly depend on crystallite size and its isolation degree, and their variation is characteristic for a single-domain magnetic particles. Our investigation finds out that average crystallite size and its isolation degree can be controlled, and the magnetic properties optimized, by choosing appropriate Ni-W composition. For example, typical Ni-W films, 13 wt % W in composition, behave as a system of perpendicular Ni columns 12.5 nm in diameter embedded in an amorphous Ni-W matrix with high perpendicular magnetic anisotropy, and each crystallite would correspond to one information bit. These kind of samples exhibit semi-hard magnetic characteristics: saturation magnetization Ms = 419 kA/m, in-plane coercivity $H_{c//}$ = 49 kA/m, $H_{c\perp}$ = 118 kA/m, quite high squareness ratio S = 0.6 and very high coercivity squareness S^* = 0.83. These magnetic characteristics are in well agreement with the required parameters for a high density magnetic recording medium.

Corresponding author: Professor N. Sulițanu, Department of Solid State Physics, Faculty of Physics, "Al.I.Cuza" University, 11 Carol I Blvd., RO-6600 Iaşi, Romania