Nanocomposites and nanomaterials

Magnetic properties of three-layers film systems based on Ni and Dy

O.V. Shutylieva[1], S.I. Vorobiov[1], A.M. Chornous[1]

[1] Sumy State University
2, Rymskogo-Korsakova st., 40007 Sumy,Ukraine
E-mail: olya.shutileva@gmail.com

The thematic justification of finding new combinations of metals due to the creation of modern magnetic recording media information with stable performance characteristics in the required temperature range. These structures can be multilayer films based on ferromagnetic and rare earth metals, which are of interest due to the peculiarities of antiferromagnetic ordering. When selecting materials, the basic magnetic characteristics are residual magnetization (M_r), coercitive force (B_c) and saturation magnetization (M_s), which can be determined from the hysteresis loops. These parameters define performance elements sensors, magnetic memory elements, and so on.

This paper presents the results of research in these parameters three-layer film system Ni (5) / Dy (x) / Ni (10) / S (where S substrate, x – effective thickness of rare-earth metal that varies from 1 to 20 nm).

The samples were obtained by electron-beam method on glass ceramics substrate that were heated (T_s = 460 K). Heat treatment was carried by scheme «heating – exposure 15 min → cooling» to temperature annealing T_a = 700 K. The studies of magnetic properties were carried out at room temperature in parallel geometry measurement (lines of induction magnetic field were directed parallel to the sample surface) using a vibrating magnetometer VSM Lake Shore.

Investigation of the magnetic properties of the films after condensation showed that an increase in the effective thickness Dy appear characteristic inflections that indicate layer reversal.

The dependence of coercitive force before and after annealing has a oscillation character. For films after condensation the minimum value of B_c = 1,7 mT (at d_{Dy} = 7 nm) and maximum value of B_c = 3,3 mT (at d_{Dy} = 1 nm). After annealing the value of coercitive force are increases by an average of 30%. Low values of coercitive force indicate about possibility of reversal these film systems at relatively small values of the magnetic field. For saturation magnetization and residual magnetization reversible character is being observed when the effective thickness of the Dy layers increases the values of M_r and M_s are decreases.