ABSTRACT

Dissertation: 112 pages, 43 figures, 7 tables, 58 references.

The dissertation work was carried out within the framework of Leonard Eiler's programme project of DAAD foundation (German Academic Exchange Service) on ID 57198300 grant.

Objective: the investigation of structural, phase composition and magnetic properties of thin film compositions based on FePd and FePt after heat treatment.

To achieve this goal the following tasks were resolved:

1. Overview of current literature on the subject and identifying promising directions for research.
2. To study the structure and magnetic properties of $Fe_{50}Pd_{50}$(5 nm) and FePd(5-4,7 nm)/Cu(0,3-0,9 nm) film compositions after deposition and thermal treatment in vacuum/N_2 atmosphere. To analyze the results.
3. To investigate the influence of additional Cu layer on structure, phase formation and magnetic properties of films based on FePd after heat treatment in vacuum/N_2 atmosphere.
4. To study the structure and magnetic properties of $[Fe(3,2\ nm)/Pt(4,2\ nm)]_4$ and $[Fe(1,61\ nm)/Pt(21,2\ nm)]_8$ multilayers after deposition and thermal treatment in vacuum/N_2 atmosphere. To analyze the results.
5. To investigate the influence of layer's number on on structure, phase formation and magnetic properties of multilayer's based on FePt after heat treatment in vacuum/N_2 atmosphere.

Objects of research: processes of structure and phase formation of $Fe_{50}Pd_{50}$(5 nm), FePd(4,7-4,1 nm)/Cu(0,3-0,9 nm), $[Fe(3,2\ nm)/Pt(4,2\ nm)]_4$ and $[Fe(1,6\ nm)/Pt(2,1\ nm)]_8$ nanoscale film compositions after heat treatment.

Subjects of research: FePd(5-4,1 nm)/Cu(0-0,9 nm) nanoscale film compositions and multilayer's $[Pt(4,2\ nm)/Fe(3,2\ nm)]_{4x}$, $[Pt(2,1\ nm)/Fe(1,6\ nm)]_{8x}$ after deposition and heat treatment.

Methods of research: magnetron sputtering, heat treatment in vacuum, rapid thermal annealing, X-ray phase analysis, atomic-force microscopy, SQUID-magnetometry, scanning electron microscopy.

Scientific novelty:

1 The long-termal heat treatment in vacuum of FePd and FePd/Cu film compositions results to formation of $L1_0$-FePd phase with random grain orientation that causes isotropic magnetic properties of the material;

2. Introduction of additional Cu layer in the film compositions based on FePd reduces surface roughness after heat treatment, that shown by atomic force microscopy results;

3. There is most strong [001] texture forms in structure of films compositions based on FePt with less layers number during heat treatment, that is probably caused by larger grain size of $L1_0$-FePt phase. The introduction of additional Fe/Pt layer's in multilayer film composition with constant total film's thickness prevents grain growth of $L1_0$-FePt phase during heat treatment;

4. The rapid thermal annealing of multilayers in N_2 atmosphere initiates the formation of $L1_0$-FePt phase with randomly oriented grains in film's structure that causes magnetically-isotropic properties;

5. The rapid thermal annealing initiates additional mechanical stresses in material, that can be driving force as for grain growth process (that leads to increase surface roughness) as well for ordering processes. The high temperature rapid thermal annealing of $[Fe(3,2\ nm)/Pt(4,2\ nm)]_4$ and $[Fe(1,61\ nm)/Pt(2,12\ nm)]_8$ causes the ordering process with surface roughness thermal stabilization.

Practical importance: the results have practical use for development of new nanoscale materials promising for ultrahigh density magnetic recording.

NANOSCALE MULTILAYER FILM COMPOSITIONS BASED ON FePt; FILM COMPOSITION BASED ON FePd WITH INTERMEDIATE Cu LAYER; ULTRAHIGH DENSITY MAGNETIC RECORDING; FACE-CENTERED TETRAGONAL LATTICE; STRUCTURE AND PHASE TRANSFORMATION