The Third International Conference "Problems of Cybernetics and Informatics"
September 6-8, 2010, Baku, Azerbaijan. Section #1 "Information and Communication Technologies"
www.pci2010.science.az/1/07.pdf

PROBLEMS OBTAINING NANOCOMPOSITE MATERIALS FOR SUPERDENSE RECORDING

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Each year the need to process and store large amounts of information. Therefore, the main challenge in the field of informatics and computer science at present is to increase the areal density and development of new structural materials, as well as studying their properties. To solve this problem it is necessary to reduce the size bits of information. It turned out that the easiest to obtain such a microstructure, which would satisfy the requirements for memory devices for superdense recording, you can nanogranules film materials. As is known, magnetic granular composites are two-phase system of ferromagnetic particles in a dielectric matrix. For most transition metals such as Fe and Co, granules can be sized from a few to several tens of nanometers. The properties of granular nanocomposites is critically dependent on the volumetric concentration of the ferromagnetic component, which can vary up to 100% assumes that each magnetic particle has a granular alloy 1 bits of information. Design and manufacture of such systems nanogranules most depends on the level of technology development, which should allow to obtain atomic precision structure necessary configuration and dimension. Granular magnetic systems can be obtained by different methods of deposition, ion implantation, electron-beam lithography [1-4]. However ion-plasma magnetron sputtering is the most universal method. An important feature of granulated composites a limited number of pairs of metal-insulator transition, in which it is possible to obtain such a heterogeneous structure. Indispensable condition of its formation is nonwettability and insoluble components in each other, the surface energy of the ferromagnetic phase should be larger than the surface energy of the matrix material. If these conditions are met, then in the process of forming a composite deposited metal atoms will be collected in pellets whose dimensions are determined by the phases of receipt. Phase dielectric will also be formed separately from the metal phase. Various technological methods including annealing, to the point that small ferromagnetic particles uniformly distributed in a nonmagnetic matrix. Since the nanostructure of granular materials is very sensitive to technological parameters, such as settling velocity, pressure and atmosphere in the sputtering chamber, substrate temperature, all these conditions must be carefully monitored. Structure of nanocomposite materials have nanometer dimensions, so the information about the real morphology of composites formed in the manufacturing process can be obtained using transmission electron microscopy. The size of magnetic particles of granular nanocomposites used for recording information, must not exceed 5-10 nm to maintain high signal to noise ratio when reading data. With decreasing size of nanoparticles granular composite up to 10-20nm increases the value of the demagnetizing field. To ensure that such materials could be successfully used to create the memory elements, they must have a large coercive force of about 5 kOe. However, the phenomenon of superparamagnetism manifests itself in granular materials at small sizes of nanoparticles leads to the temperature dependence of coercivity and to increase the coercivity of granular alloy, it is necessary to raise the temperature of transition to the superparamagnetic state. This requires the establishment of anisotropy in an ensemble of nanoparticles due to the exchange and dipole interactions. In this case, we need to establish an ordered structure. Methods of manufacturing such materials based on the nanocrystals are very complex and are still under development. However, the establishment of modern information carriers used alloys with large crystal anisotropy. Currently the most promising magnetic materials for superdense recording over 100Gb/sm are granular-based alloys of ferromagnetic particles FePb and CoPt, embedded in a dielectric matrix. Such films obtained by magnetron sputtering or deposition, have fairly uniform distribution of particles. In size, but they are in the disordered state. For ordered structures with strong perpendicular uniaxial anisotropy and excellent hard magnetic characteristics, which should have a magnetic material in memory devices, require high-temperature processing. After high temperature treatment increases the size of nanoparticles, formed an ordered structure.

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