Fabrication of Hard Magnetic Alloy Nanoparticles by Vapor-Deposition and Their Electron Diffraction Structure Analysis and Magnetic Property Measurements

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【Outline of survey】

Recent developments of high-density magnetic recording media require a higher storage density with very fine hard magnetic grains of media materials smaller than 10 nm in size. This research aims at a low temperature fabrication of 5 nm-sized hard magnetic isolated alloy nanoparticles with orientation embedded in an insulating film, and to study relations (1) between hard magnetic property and degree of atomic order of the ordered alloy nanoparticles, and (2) between room-temperature hard magnetism and size of nanoparticles, which are quite important to realize the next generation hard magnetic recording media. For the hard magnetic nanoparticles, FePt and FePd ordered alloy nanoparticles with the L1o-type structure are chosen. A low temperature epitaxial growth of these particles as small as 5 nm or less will be performed using a successive or co-depositions of Pt (or Pd) and Fe onto a single crystal (MgO or NaCl) substrate heated at about 300 °C followed by a deposition of amorphous Al_2O_3 as an insulating layer embedding the particles. Structural and morphological analyses of these nanoparticles will be made using high-resolution electron microscopy and electron diffraction techniques. Magnetic properties will be measured using a super-conducting quantum interference device magnetometer.

【Expected results】

Hard magnetic nanoparticle films to be fabricated by this research satisfy the requirements for the ultra-high density magnetic recording media: (1) two dimensional homogeneous dispersion of hard magnetic nanoparticles, (2) particle sizes below 10 nm, (3) insulating matrix embedding the nanoparticles, (4) in-plane or perpendicular oriented nanoparticles, and (5) low temperature synthesis as low as 300 °C. Detailed experimental results obtained by this research will clarify relations (a) between hard magnetic property and degree of atomic order of the ordered alloy nanoparticles, and (b) between room-temperature hard magnetism and size of nanoparticles. These relations will be helpful in production of the next-generation high-density hard magnetic recording media with memory densities of the order of Tb/in^2.

【References by the principal researcher】

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【Term of project】 FY 2004 — 2008

【Budget allocation】 84,800,000 yen

【Homepage address】 http://www.sanken.osaka-u.ac.jp/labs/scd/