NT-P13

Possibilities of nitrogen-doped FePt thin films as a new ferromagnetic free layer for the application of STT-MRAM devices

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Recently, amorphous ferromagnetic electrode was utilized in magnetic tunnel junctions (MTJs), and enhancement of tunneling magnetoresistance (TMR) was reported. These MTJs make them suitable for the industrial development of unique spin devices, such as spin transfer torque magnetic random access memory (STT-MRAM) and magnetic recording heads. In this work, the properties of nitrogen doped FePt films incorporating partial pressure of nitrogen gas are reported as new ferromagnetic electrode. These films was simply controlled to be either amorphous or nanocrystallin, depending on the nitrogen partial pressure, thickness, and thermal treatment. Nitrogen-doped FePt films were deposited on thermally oxidized Si substrates in an Ar and N_2 gas mixture by using a dc magnetron sputtering system with a base pressure of 1×10^{-7} Torr. The dependence of the structural and magnetic properties on various nitrogen partial pressure (defined as $R_{N2} = P_{N2} / (P_{N2} + P_{Ar}) \times 100$ %), thickness and post-thermal treatment were systematically studied. These films were simply controlled either to be amorphous or nanocrystalline or to have low coercivity (Hc), depending on deposition conditions. The structural properties of samples were determined by the X-ray diffraction using Cu Kα radiation and the magnetization was measured by the vibrating sample magnetometer at room temperature. The properties of new FePtN thin films doped by partial pressure of nitrogen gas exhibits promising possibility for the application of STT-MRAM devices.