研究論文

$L1_0$型FePtRh規則合金薄膜における強磁性—反強磁性相変化とナノ構造体の作製

長谷川　崇,* 川戸宏紀,* 山根治起,** 石尾俊二*

Fabrication of nanodot array using ferro-antiferromagnetic transition in $L1_0$ FePtRh film

Takashi HASEGAWA †, Hiroki KAWATO †, Haruki YAMANE *† and Shunji ISHIO *

Crystalline structure and magnetic properties of $FePt_{1-x}Rh_x$ films (6.12 nm thick) were studied, and a bit patterning process using magnetic phase transitions was investigated. [001]-Oriented $L1_0$(CuAu I type) ordered films with a face-centered tetragonal structure (fct; $a=b>c$) were prepared in the range of $0 \leq x \leq 0.40$ after annealing at 973 K. A degree of long-range chemical order parameter was calculated to be S~0.98 in all of the films. At room temperature, the films with $0 \leq x \leq 0.32$ were in a ferromagnetic (FM) phase with a coercivity of several kilo-oersteds, and the films with $0.34 \leq x \leq 0.40$ were in an antiferromagnetic (AF) phase. The uniaxial magnetocrystalline anisotropy energy of the films with FM phase was more than 10^7 erg/cm^3. Using this material system, a new bit patterning process was proposed. Atomic diffusion was used for modifying the composition of the film. Only the magnetic phase of the area whose composition crossed the threshold of the FM-AF transition changed abruptly to the FM phase. A minimum dot size of 300 nm × 300 nm was realized by this method. A multi-domain structure was observed by the magnetic force microscopy at room temperature, and the FM dots were saturated by a magnetic field of 5.5 kOe. These results suggest realizing the advantaged bit patterning process.

Key Words : $L1_0$FePtRh film, ferromagnetic-antiferromagnetic transition, ordered alloy, atomic diffusion, annealing, patterning, nanodot