Synthesis and self-assembly of shape-controlled $L1_0$-FePt nanoparticles by a temperature-modulated process

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Recently, self-assembled FePt nanoparticles (NP) in face-centered tetragonal phase (fct) have been synthesized as potential candidates for Ultra-High Magnetic Recording Systems (UHMR) due to high magnetocrystalline anisotropy[1,2]. However, the magnetic alignment of these self-assembled fct-FePt nanoparticles also has been a limiting factor, since the axes of easy magnetization of spherical NP are presented randomly oriented in three directions[3,4]. Concerning to avoid these restrictions arising from magnetic alignment, one-dimensional NP perpendicularly oriented on the magnetic medium surface has been reported as a possible solution for texture and magnetic alignment[3,4]. To date, the reported nanorods (NR) and nanowires (NW) synthesized in the literature showed face centered cubic phase (fcc) which present poor magnetocrystalline anisotropy, instead the fct desirable phase, and were found to be thermally unstable resulting in spheroidal NP after annealing required to phase transformation from fcc to fct[3,4]. In this work, $Fe_{55}Pt_{45}$ NP with morphologies varying from nanospheres, NR with different lengths up to NW were synthesized by a temperature-modulated[5]. Furthermore, this experimental procedure resulted in an fct/fcc ratio close to 1:1 for the as-synthesized nanoparticles. Either longitudinal or perpendicular self-assembled NR systems in a hexagonal compact array were obtained using oleic acid (OA) and oleylamine (Oam) or hexadecylamine (HAD), respectively, as molecular organic spacers. Perpendicularly oriented NR system led to magnetic alignment due to shape anisotropy and combined with the magnetic properties due to partial tetragonal phase suggest a strong future candidate to ultra-high magnetic density recording applications capable to achieve density of Terabits/in^2.

Keywords: Magnetic recording; FePt nanorod; Self-assembled; Temperature-modulated process

Work supported by CNPq and FAPESP.

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