Introduction
Ordered FePt with the face-centered tetragonal structure exhibits excellent intrinsic magnetic properties and is therefore a suitable candidate for permanent magnet applications and ultrahigh-density magnetic recording media. The high theoretical energy product value is expected for homogenized and textured nanostructured FePt and FePt/Fe₃Pt permanent magnets. This report describes a unique approach to obtain anisotropic nanostructured FePt and FePt/Fe₃Pt magnets with crystallographic texture of the hard phase: cyclic cold-rolling plus subsequent high magnetic field annealing (HMFA).

Experimental
Cyclic sheath cold rolling of a composite stack of 12 bi-layers of Fe and Pt foils was used to create nanolaminate Fe/Pt foils. The as-rolled foils were then processed by the HMFA. The annealed foil samples were checked by X-ray diffraction and SQUID magnetometer.

Results and Discussion
Magnetic-field-induced crystallographic texture and magnetic property enhancement were observed in both cold-deformed FePt and FePt/Fe₃Pt nanostructured magnets. Compared with the FePt and FePt/Fe₃Pt samples annealed without a magnetic field, the annealing in the presence of both out-of-plane and in-plane 19 T magnetic fields enhances texture of the hard FePt phase by about 50 and 58 %, respectively (see Fig.1). Consequently, annealing samples in a 19 T field improves the intrinsic coercivity $\mu_0H_c$, the remanence $J_r$, and energy product ($BH_{max}$). Especially, ($BH_{max}$) was increased by 21 - 25 % for the FePt and Fe₆₂Pt₃₈ alloys (see Fig.2). Magnetically anisotropic behavior was observed in the magnetically annealed samples (see Fig.3). It is suggested that cold-rolling-induced strong textures of Fe and Pt in the Fe-Pt nanolaminate structure and magnetic-field-assisted phase transformation and preferred grain growth should be responsible for the noticeable improvement of the crystallographic texture and magnetic properties in the magnetically annealed samples.

Conclusions
This work reports cyclic cold-rolling plus subsequent HMFA as a promising approach to fabrication of bulk anisotropic nanostructured FePt and FePt/Fe₃Pt magnets.

References