

Nanocomposites and nanomaterials

Low-temperature diffusion in Pt/Fe and Pt/Au/Fe thin films

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Nanoscaled thin films based on ordered $L1_0$ -FePt phase are prospective candidates for applications as ultra-high density magnetic recording medium due to their strong magneto-crystalline anisotropy [1]. However, after deposition onto room temperature substrates FePt films have $A1$ /disordered structure with low magnetic properties.

It is known that even at low temperatures when bulk diffusion processes are practically frozen almost full intermixing of components in thin film heterostructures can occur through grain boundary diffusion and grain boundary diffusion induced motion. Also it is well known that introduction of third elements such as Ag, Au or Cu into FePt-based films is an effective approach to decrease substantially the $L1_0$ ordering temperature.

In this study, the effect of an intermediate Au layer on the evolution of the low-temperature FePt phase formation in Pt/Au/Fe thin films was investigated.

X-ray diffraction analysis and SNMS chemical depth profiling showed that the introduction of an additional intermediate Au layer leads to an enhancement of the low-temperature intermixing of nanocrystalline Fe and Pt thin films. The intermixing at relatively low temperatures is caused by the grain boundary diffusion induced reaction layer formation mechanism. At the same time the ordering is also enhanced, leading to the appearance of the chemically ordered $L1_0$ -FePt phase, which results in a strongly increased coercivity. Enhanced chemical $L1_0$ ordering is interpreted by stresses developed during the formation of the disordered $A1$ FePt phase along grain boundaries: in some of the new grains formed, where compressive stress occurs along the $\{100\}$ directions, chemical ordering can take place [2].

1. Weller D., Mosedenz O., Parker G., Pisana S., Santos T.S. $L1_0$ -FePtX-Y media for heat-assisted magnetic recording // Phys. Status Solidi A.-2013.-**210**.-P. 1245.
2. Vladymyrskyi I.A., Gafarov A.E., Burmak A.P., et al. Low-temperature formation of the FePt phase in the presence of an intermediate Au layer in Pt /Au /Fe thin films // J. Phys. D. Appl. Phys.-2016.-**49**.-P. 035003.