TEM Study for Electronic Article Surveillance Magnetic Sensors

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A comparative microstructural study of field annealed Co-rich amorphous alloys (CoFeBSi) was carried out using transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM).

Our results reveal new details of the process of surface crystallization in these metastable materials. Surface crystallization occurs for annealing in air well below the bulk crystallization temperature and involves a sequence of three steps : 1) formation of an amorphous borosilicate surface oxide layer, 2) depletion of glass stabilizing elements (boron and silicon) from the underlying amorphous metal substrate, and 3) primary crystallization of the destabilized, metal-enriched sub-surface layer to an fcc or hcp cobalt phase.

Also, we have found evidence for a new microscopic mechanism for field induced anisotropy of Co-rich amorphous alloys. Striking difference in the microstructural morphology were observed for different Co-rich amorphous alloy compositions. The degree of field induced anisotropy correlates with the structure and faulting of the surface crystallized layer. Exchange anisotropy is stronger when the crystallized surface is dominated by faulted fcc or hcp Co-rich crystallites. It is weak when the surface crystallites have the unfaulted hcp or fcc structure.

With the detailed microstructural analysis, we suggest a novel mechanism for the exchange anisotropy and the domain wall pinning.

**Time permitting, other problems encountered during development of magnetic sensors (harmonic and magnetoelastic sensors) will be discussed.