

9th International Workshop on Electrodeposited Nanostructures

Electrodeposition of CoFe in the presence of p-hydroxycoumaric acid (p-HCA): Incorporation of p-HCA and oxygen in the deposit

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It has been reported that electrodeposition of CoFe in the presence of organic acids results in ~4 wt% O and ~1.2 wt% in the deposit [1]. The chemical structure of these alloys was assigned as Fe-Co-C based on XPS analysis of carbon in the deposit.

Electrodeposition of CoFe performed in the presence of p-HCA additive produced a ternary $\text{Co}_{30}\text{Fe}_{37}\text{O}_{28}\text{C}_{12}$ alloy based on RBS composition analysis. Using the HPLC analysis of the solution of the dissolved deposit in HCl we have clearly demonstrated that the source of carbon is the p-HCA molecule incorporated in the deposit together with 3-(p-hydroxyphenyl)-propionic acid, which is the reduction product of p-HCA, formed during electrodeposition. It is important to note that the HPL chromatogram of plating solution resembles the chromatogram of the solution of the dissolved deposit. This was also observed earlier in the case of electrodeposition of CoFe in the presence of saccharin additive [2].

The electrochemical experiments, coupled with CV-EQCM, indicate that p-HCA affects the reduction of Fe^{+2} ions, but not Co^{+2} ions. This observation is in accordance with XPS and TEM analysis of the amorphous nano-crystalline deposit which shows that Co is present in the form of the metal and Fe is present as a Fe-oxide.

References:

- [1] N.Miamoto, S. Sakamoto, H. Tamura, M. Matsuoka, and J. Tamaki, "Effect of carbon content on structural and mechanical properties of Fe-Co-C alloy electrodeposited from aqueous solutions" J. Electrochem. Soc., **152**, C488 (2005).
- [2] I. Tabakovic, S. Riemer, K. Tabakovic, M. Sun, and M. Kief, "Mechanism of saccharin transformation to metal sulfides and effect of inclusions on corrosion susceptibility of electroplated CoFe magnetic films" J. Electrochem. Soc., **153**, C586 (2006).