# Influence of Additive Adsorption on Properties of Electrodeposited Soft High Magnetic Moment CoNiFe Alloys.

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Organic additives have been commonly used in the formulation of electroplating bath chemistries[1]. The properties of the electrodeposited magnetic alloys, very often, have been found to be critically dependent on the choice of one or more additives and their interaction with the metal surface[2]. Their action during the plating was usually attributed to the improved grain size and the crystal structure of the deposit[3], stress reduction[3,4], suppression of hydrogen evolution[4], and improved deposit corrosion resistance[5]. Recently, it was demonstrated that the appropriate choice of the additives could substantially improve the magnetic properties of CoNiFe films[6]. Very soft CoNiFe alloys with coercivity less than 2 Oe and high magnetic moment (>1.8T) were produced [7,8] leading to substantial breakthrough in electroplated head core materials used for high density recording.

Depending on the nature of the particular additive used and its role in the plating bath, different atomic interstitials like S, C, Cl, B… or their intermetallic compounds are found in the deposit. Their amount can be as high as several atomic percents (at%) or barely detectible with conventional analytical techniques (few ppm). Since the interstitials presence is sometimes crucial for desired magnetic properties and crystal structure of CoNiFe alloys, it is very important to understand the correlation between the parameters defining the additive adsorption on metal surface and the rate of their incorporation in the deposit.

In this talk we present recent results obtained for direct current (DC) and pulse current plated (PP) CoNiFe alloys, investigating a potential of maximum additive (SLS[9] and Saccharin) adsorption on CoNiFe surface and its correlation to the electrode potential during deposition. The potential of maximum additive adsorption is determined by examining voltammetry curves and differential capacitance spectra obtained from impedance measurements. The amount of S and C incorporated in the CoNiFe deposit was correlated to the potential of the electrode surface during electrodeposition and these findings are correlated to the estimated potential of maximum additive incorporation (Figure 1). We also found that depending of the magnitude of pulse or direct current used in plating experiments a different conditions for additives adsorption are formed and different amounts of S and C are incorporated in the deposit, influencing the crystal structure, grain size and coercivity of the CoNiFe films (Figure 2).

The results clearly demonstrate that for the same additive formulation in the plating bath and the same composition of the deposit, very different properties of magnetic materials can be obtained. This depends strongly on the potential of the metal electrode and its relative position with respect to the potential of maximum additive adsorption. We believe that these findings will improve our current understanding of the role of additives in plating and help us define the optimal conditions for plating which will result in deposition of CoNiFe alloys with optimal magnetic properties.

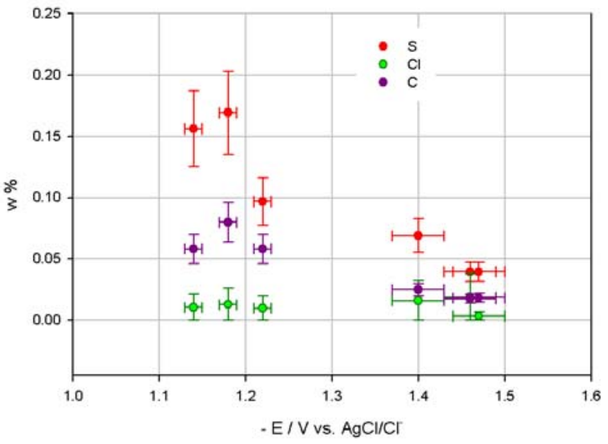

**Figure 1. Interstitials content in CoNiFe deposit vs. the electrode rest potential during the pulse plating.**

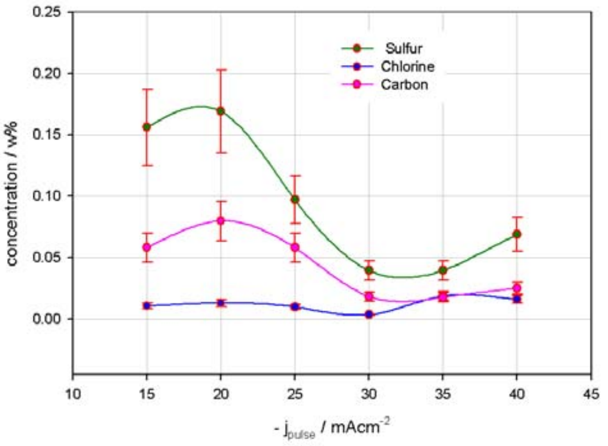

**Figure 2. Interstitials content in CoFeNi deposit vs. the magnitude of the pulse current during the pulse plating.**

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## References

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