Magnetic Studies of Low-dimensionality Electrodeposited Metal Structures

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Recently, there has been a growing interest in the study of the formation of thin films and multilayers of metals that are known to display interesting magnetic properties. Electrodeposition has proven to be an economical method of producing high-quality, technologically-useful thin films, low-dimensional surface features (nanostructures) and multilayer films. Although multilayer structures are of great interest, much knowledge can be gained in this area by understanding the nucleation and growth processes that are involved in the formation of the individual layers on well-defined substrates and correlating this information to the layer's magnetic properties. We strive to understand the important microscopic processes taking place during nucleation and growth, and to understand their impact on a layer's magnetic properties.

The work reported here builds on earlier studies of the electrodeposition of Ni on Ag(111) [1,2]. After Ni and Co thin films or nanostructures are electrodeposited on well-defined surfaces, their structures and morphologies are characterized with in-situ scanning tunnelling microscopy and various electroanalytical methods, including cyclic voltammetry. Additionally, magneto-optical Kerr effect measurements (MOKE) are used to assess magnetization behaviour of these low-dimensional structures.

This presentation will describe our MOKE measurement apparatus and the preliminary magnetic data it has yielded for thin Ni and Co films deposited on Ag(111) and Ag(100). Our results will be compared with the magnetic properties of similar films produced under UHV conditions [3,4,5] On Ag(111), we observe ferromagnetic character in Ni films whose thicknesses are on the order of ten layers. The in-plane magnetization component shows little anisotropy as a function of sample orientation, suggesting the absence of an easy magnetization direction. No MOKE signal was detected for thinner Ni deposits (1-2 ML), similar to the findings of Allongue et al. for Ni/Au(111).[6] This may be related to hydrogen absorption into the Ni film, which could disrupt ferromagnetic character (as proposed in ref. [6]). Alternatively, the documented Ni(111) lattice expansion, observed in the first 4-5 ML of Ni electrodeposited on Ag(111)[2], may adversely affect ferromagnetic behaviour in such thin films.

References

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