Chemical & Environmental Engineering

2009 - 2010 Colloquium Series

Jay A. Switzer

Professor

Department of Chemistry and Materials Research Center

Missouri University of Science and Technology

Electrodeposition of Ceramic Superlattices and Chiral Films

In this talk we show that ceramic superlattices based on Fe_3O_4 and chiral films based on CuO can be electrodeposited. In the deposition of superlattices we use the fact that the departure from equilibrium is controlled through the applied overpotential. Films of ferrimagnetic Fe_3O_4 can be deposited with stoichiometries which depend on the applied potential. We prepare the films by the reduction of a Fe(III)-TEA (triethanolamine) complex at 80 °C in strongly alkaline solution. Superlattices of the material are electrodeposited by pulsing the applied potential between -1.01 and -1.065 V vs. Ag/AgCl. A particularly interesting feature that the superlattices exhibit is resistance switching during perpendicular transport measurements.

Chiral films of CuO are electrodeposited by exploiting the fact that chiral molecular additives can break the symmetry on achiral surfaces of fcc metals such as Au and Cu to produce chiral orientations of CuO. Chiral surfaces lack mirror or glide plane symmetry. Chiral surfaces offer the possibility of developing heterogeneous enantiospecific catalysts that can more readily be separated from the products and reused. These surfaces might also serve as electrochemical sensors for chiral molecules. Our approach to produce chiral surfaces is to electrodeposit low symmetry metal oxide films with chiral orientations on achiral substrates. We have deposited chiral orientations of monoclinic CuO (which is intrinsically achiral) onto single-crystal Au and Cu using both tartaric and malic acid and the amino acids alanine and valine to control the handedness of the electrodeposited films. Electrochemical chiral recognition experiments show that the chiral orientations also expose chiral surfaces. Chiral recognition is enhanced by etching CuO films in solutions of tartaric acid. Chiral nanostructures of calcite are also deposited by "electrochemical biomineralization."

Friday October 16, 2009

9:30 - 10:30 AM

Bourns A265

Refreshments at 9:15 AM

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