Electrochemically Induced Atom-by-Atom Growth of Compound Semiconducting Thin Films: A New Approach for Electrochemical Co-deposition

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ABSTRACT

Size-quantized thin films of PbS, CdS and ZnS were electrodeposited on Au(111) substrates using a novel and practical electrochemical method at a constant potential. The appropriate electrodeposition potentials based on the underpotential deposition potentials (upd) of Cd, Pb, Zn and S has been determined by the cyclic voltammetric measurements. These films were characterized by X-ray diffraction (XRD), scanning tunneling microscopy (STM), atomic force microscopy (AFM), energy dispersive spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS), and UV-Visible-NIR absorption spectroscopy techniques. AFM, STM, and XRD results indicate that growth of these thin films follows atom by atom growth mechanism resulting highly crystalline thin films in cubic structure grown at a kinetically preferred orientation on Au (111). EDS and XPS analyses of films confirm that the precursors in compound semiconductors are present in approximately 1:1 atomic ratio in the films. UV-visible absorption measurements as a function of film thicknesses (ranging from 1-80 nm) indicated that the band gap of the films increases as the thickness decreases.

References:
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