Electrodeposition of CdTe on Te modified InP(100)

Madhivanan Muthuvel and John L. Stickney
Department of Chemistry
University of Georgia
Athens, GA 30602

Metallic substrates such as Au, Ag, and Cu have been extensively used for studies on electrodeposition of compound semiconductors using Electrochemical Atomic Layer Epitaxy (EC-ALE). In the present study, a III-V compound semiconductor – InP(100) has been explored as a substrate for deposition of CdTe using EC-ALE. An ultrahigh vacuum electrochemical (UHV-EC) system was used to study and analyze the electrodeposition of CdTe on InP(100) surface.

A n-type InP(100) single crystal wafer was pretreated with 10% HF solution for 40 seconds in order to remove SiOx particles on the surface of the wafer. InP(100) crystal was cleaned in UHV chamber by ion bombardment and annealing, which resulted in a carbon and oxygen free surface with (2X4) surface structure. This InP surface is referred to as 'clean' InP(100). Metallic Indium clusters were found on the surface of 'clean' InP, which was oxidized in 10 mM HCl solution at -600 mV to form 'stable' InP(100) with (1X1) LEED pattern. The surface composition of both 'clean' and 'stable' InP(100) were same.

Electrodeposition of Cd on 'stable' InP using a Cd solution, pH 4.75, resulted in deposition of only bulk Cd with nucleation and growth mechanism. Underpotential deposition (UPD) of Cd was not observed on 'stable' InP(100) surface, while on Te covered InP, electrodeposition of UPD Cd was observed. Electrodeposition of Te on InP also displayed bulk deposition, but an atomic layer of Te on InP(100) was formed by reduction of excess Te in 1 mM K_2SO_4 and 1 mM $Na_2B_4O_7$ (pH 9) solution. The effect of number of Te monolayers on InP on the deposition of Cd UPD was studied in this investigation. Modification of InP surface with Te helped in deposition of Cd UPD on InP(100). Surface modification of InP with Te has lead to the formation of Indium telluride (In_2Te_3) another semiconductor. The atomic layer of Te left after the reduction of excess Te in pH 9 solution forms the first monolayer of In_2Te_3 on InP(100) surface.