Electrodeposition of CdTe in Aqueous Medium and Aluminum metal in a Nonaqueous Medium

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Inroduction:

Cadmium telluride (CdTe) has been well recognized as a candidate for low cost thin film solar cell application because of its near ideal bandgap and high absorption coefficient of light. For the low cost fabrication of solar cells several studies [1-3] were carried out for the electrodeposition of both n- and p-type CdTe.

Aluminum is one of the most abundant metallic elements in the Earth's crust. While aluminum occurs most commonly as aluminosilicates, its extraction from them is quite difficult. It is, therefore, produced from bauxite in a two-step procedure. The method of electrodeposition of aluminum from molten salt solution involves high temperature (around 900 to1200^{o}C). To minimize the cost of production, studies [4-6] were carried out to electrodeposit aluminum at low temperature using non-aqueous solvents.

The main focus of this paper is to demonstrate the synthesis of both n- and p-type CdTe films by electrodeposition from an aqueous bath and characterize their bandgap by photoelectrochemical studies. We also demonstrate the electrodeposition of aluminum from aluminum bromide solution in toluene at room temperature.

Experimental:

The successful electrodeposition of both n-CdTe and p-CdTe were carried out at elevated temperature of 80 - 90 ^{o}C in aqueous medium bath containing 0.5M $CdSO_4$, 0.05 M H_2SO_4.and solid TeO_2 to maintain a constant 0.05 M $HTeO_2^+$ concentration. The CdTe was electrodeposited on conducting tin oxide coated glass substrate under potential control at –0.4 to 0.4 V vs Ag/AgCl reference electrode at 83 ± 2 ^{o}C. A platinum wire was used as the counter electrode. The n and p-type characteristics were identified from the results of their photoresponse as a function of electrode potential. The bandgap energy of the electrodeposited CdTe was determined from the results of photocurrent density under monochromatic light illumunation.

Electrodeposition of aluminum metal was carried out at room temperature at –1.66 volt vsPt wire in1 M $AlBr_3$ solution in toloune using 0.5 M tetrabutyle ammonium bromide (TBAB) as the supporting electrolyte. Pt wires were used also both as working and the counter electrodes. The Al metal was identified by EDS analysis and surface morphology was determined using scanning electron microscopy (SEM).

Results and Discussion:

The photocurrent–potential dependence in 1 M NaOH solution indicates that the CdTe electrodeposited at –0.4 Volt and 0.4 volt vs Ag/AgCl has p-type and n-type chjartacteristics respectively. The highest photocurrent density and lowest bandgap of 1.55 eV were observed for p-CdTe samples electrodeposited at –0.35 volt vs Ag/AgCl and annealed for 3 hours at 250 ^{o}C. The optimum electrodeposition time for n-CdTe at 0.4 volt vs Ag/AgCl was found to be 90 minutes.

More than 90 % yield of aluminum metal was observed when it was electrodeposited on Pt metal with molar concentration ratio of 2:1 for $AlBr_3$ and TBAB in toluene at applied potential of –1.66 volt vs Pt electrode. Aluminum deposition was confirmed by EDS analysis and the scanning electron microgram (SEM) indicates formation of solid crystalline aluminum meatl rather than its powder form reported earlier [6].

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