**ELECTRODEPOSITED CIS AND CIGS THIN FILM PHOTOCATALYSTS FOR HYDROGEN PRODUCTION BY PHOTOELECTROLYSIS**

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CIGS, H2SO4, hydrogen, photoelectrochemical system, flat band potential

**Introduction**

Hydrogen production by water decomposition, storage in metal hydrides and nanotubes and subsequent use in fuel cells is one of the efficient ways of solar energy exploitation. Photoelectrochemical (PEC) water splitting represents an alternative to PV/electrolysis systems, combining a semiconductor and an electrocatalyst into a single monolithic photoelectrolysis device. This system eliminates the need for an electrolyzer and additionally reduces semiconductor processing costs involved in the fabrication of the photovoltaic modules. A lot of semiconductors may possess the minimum requirements for their application in single gap and multijunction systems.

$GaInP_2/GaAs$ and p/i/n a-Si have been identified as promising tandem cell systems for water splitting. Additionally, amorphous silicon / amorphous silicon carbide (a-Si/a-SiC) appear to be promising thin-film systems. The a-Si/a-SiC system has also shown some promise, and the a-SiC has been shown to protect a-Si-based multijunction systems from surface oxidation, further enhancing the viability of using this low cost cell. Efficiencies on the order of 7% have been realized in laboratory tests on these cells. a-SiC systems are studied in detail for their use in single layer as well as multilayer systems.

There are new concepts on monolithic polycrystalline solar cell/Photoelectrochemical structures for photoelectrolysis. CIGS has been reported to be efficient in this type of PEC systems for water splitting. But, problems related to surface degradation, kinetics of oxidation reduction etc. have to be resolved for an efficient CIGS PEC system. In this type of configuration CIGS is in contact with the alkaline/acidic solution. In the present study authors report results on photoelectrochemical and photoelectrode/electrolyte interface characteristics of CIS and CIGS thin films grown by electrodeposition and subjected to a post-deposition processing.

**Experimental**

Polycrystalline CIS and CIGS thin films used in this study were electrodeposited from an aqueous bath.. Both n and p type films were analyzed. The electrolyte used was 0.1 M $H_2SO_4$ solution. The photoelectrochemical measurements were performed with white light illumination. The I-V as well as C-V measurements were done with a computerized opto-electronic characterization system. The photoelectrochemical system consisted of a three-electrode configuration with Pt as the counter electrode.

**Results**

The variation of photocurrent with bias voltage (I-V scan) for an annealed CIS thin film under dark and illumination is displayed in figure 1. The potential is referred to MSE(mercury sulfate electrode)The figure indicates appreciable photocurrent generation at the photoelectrode, which corresponds to oxygen evolution at CIS (the anodic direction of the photocurrent indicates n-type bulk conductivity for the film) and at the same time hydrogen formation on Pt electrode. In this case it is observed that there is noticeable anodic photocurrent, which corresponds to water splitting to produce oxygen and hydrogen. But a certain bias has to be applied for water splitting. In any case this system indicates the possibility of CIS film as a potential photocatalysts for photoelectrochemical water splitting.

The capacitance - voltage measurements were done for both the systems to determine the flat band potential and carrier concentration of the films. Mott -Schottky plots ($1/C^2$ versus V) were drawn for these systems. The result for an annealed CIS film is given in figure 2. According to the Mott-Schottky plot, the film shows negative slope indicating a p-type surface conductivity. The flat band potentials were calculated as about 5 V for the film.

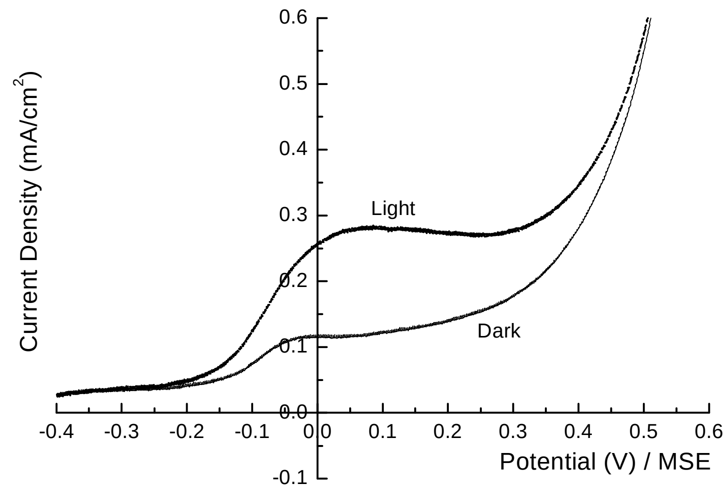


Figure 1

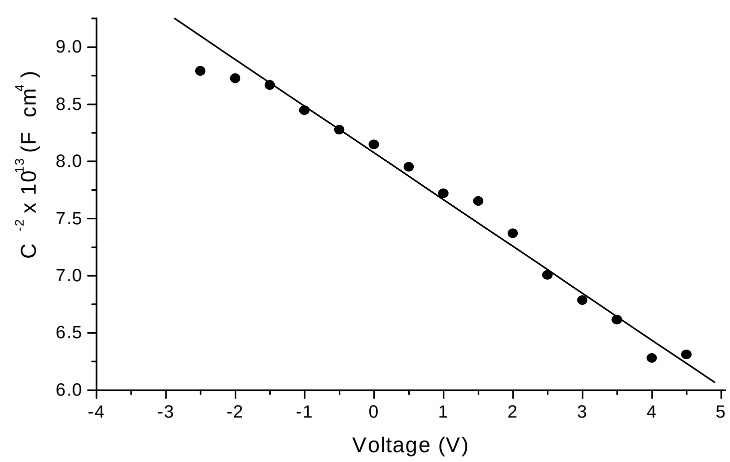


Figure 2