Photoelectrolysis of water using double-semiconductor electrodes

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ABSTRACT

Production of hydrogen by splitting water using solar energy is an attractive method to store solar energy as chemical energy. Semiconductor material cuprous oxide (Cu_2O) is a candidate material for this because it possesses important semiconducting properties suitable for application in photoelectrolysis of water. In this investigation it was studied the possibility of using n- and p-type Cu_2O thin film electrodes as a double photoelectrode system in a photoelctrochemical cell. In this system enhanced electron – hole potential energy available for the photoelectrolysis process eliminates the bias requirement. Therefore enhancement of zero bias photocurrent (ZBPC) is expected as compared with a single photoelectrode.

The n-type Cu_2O thin films were grown by potentiostatic electrodeposition. The p-type films were grown by using a thermal growth technique. Photoelectrolysis with the double-photoelectrode system was investigated in a photoelectrocehmical cell containing 0.1 M sodium acetate solution. Chopped light current-voltage measurements and phase sensitive detection method to obtain spectral responses were employed in the investigation.

It was observed that when the double electrodes were operated the ZBPC is enhanced by 450%. In other words, the requirement of an external bias could be minimized in the double-photoelctrode system. Spectral response measurements revealed that the n-type photosignal is possible in the entire band gap spectral range. This investigation demonstrates that the double-semiconductor photoelectrode system where minority carriers drive the complete photoelectrolysis process could be employed with the semiconductor Cu_2O to develop a photoelecrtolytic solar cell.