Multijunction thin film electrodes for photoelectrolysis

Rajesh Sharma, Samuel King
College of Agriculture, Engineering and Technology
Arkansas State University, Jonesboro, AR 72467

Mesut Yurukcu, Tansel Karabacak
Department of Physics and Astronomy
University of Arkansas at Little Rock, Little Rock, AR 72204

phone: (1) 870-972-2270
e-mail: rsharma@astate.edu

***Abstract*— Hydrogen is considered to be the missing link in the new energy system based on inter-mittent renewable resources such as solar and wind, where it could be used for energy distribution and storage. The process of photo-electrochemical water splitting can directly harness solar energy for hydrogen production. Significant efforts have been expanded over past four decades in developing an efficient photo-electrochemical (PEC) system. This key challenge in this effort is development of a photo-anode that is photoactive, stable, corrosion resistant and cost effective. Majority of the research so far have been directed towards development of a photoanode material that can fulfill all these requirements. However, no material so far has been able to meet these competing requirements. More recently, PEC researchers have been trying to utilize the concept of stacking multiple cells. This approach has been successfully used by photovoltaic industry in developing devices with efficiencies ex-ceeding 40%.**

A similar approach was used in this research where a multijunction thin film electrode was fabricated using titanium disulfide (TiSi2) and titanium dioxide (TiO2). The materials chosen covered an extended range of bandgap with an aim to optimize photon absorption. A DC magnetron sputtering system was used for the fabrication of TiSi2 layer superim-posed by a layer of titanium(Ti). This was followed by electrochemical anodization of Ti to create TiO2 surface microstructures. The multilayer photo-anode was tested for PEC performance, where it demonstrated enhanced photovoltage. The photocurrent density measured was comparable to several oxide semiconductors that have been studied for PEC hydrogen generation.