World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:12, No:12, 2018

Electrically Tuned Photoelectrochemical Properties of Ferroelectric PVDF/Cu/PVDF-$NaNbO_3$ Photoanode

Authors : Simrjit Singh, Neeraj Khare

Abstract : In recent years, photo-electrochemical (PEC) water splitting with an aim to generate hydrogen (H_2) as a clean and renewable fuel has been the subject of intense research interests. Ferroelectric semiconductors have been demonstrated to exhibit enhanced PEC properties as these can be polarized with the application of an external electric field resulting in a built-in potential which helps in separating out the photogenerated charge carriers. In addition to this, by changing the polarization direction, the energy band alignment at the electrode/electrolyte interface can be modulated in a way that it can help in the easy transfer of the charge carriers from the electrode to the electrolyte. In this paper, we investigated the photoelectrochemical properties of ferroelectric PVDF/Cu/PVDF-$NaNbO_3$ PEC cell and demonstrated that PEC properties can be tuned with ferroelectric polarization and piezophototronic effect. Photocurrent density is enhanced from ~0.71 mA/cm^2 to 1.97 mA/cm^2 by changing the polarization direction. Furthermore, due to flexibility and piezoelectric properties of PVDF/Cu/PVDF-$NaNbO_3$ PEC cell, a further ~26% enhancement in the photocurrent is obtained using the piezophototronic effect. A model depicting the modulation of band alignment between PVDF and $NaNbO_3$ with the electric field is proposed to explain the observed tuning of the PEC properties. Electrochemical Impedance spectroscopy measurements support the validity of the proposed model.

Keywords : electrical tuning, H_2 generation, photoelectrochemical, $NaNbO_3$
Conference Title : ICTFTA 2018 : International Conference on Thin Film Technology and Applications
Conference Location : Barcelona, Spain
Conference Dates : December 17-18, 2018