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# Enhanced light harvesting and charge separation properties of the Ti/$TiO_2$-$Sb_2S_3$ Schottky junction for enhanced Photoelectrochemical performance

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Photoelectrochemical (PEC) water splitting is a promising candidate for solar energy conversion, generating a sustainable source of energy in the form of chemical bonds without greenhouse gas emissions. In this work, we synthesized an $Ag^+$ ion-doped Ti/$TiO_2$ nanotube Array Schottky junction through a facile electrochemical synthesis strategy. Subsequently, an n/n heterostructure was introduced by coating the TNTA photoanode with an n-type stibnite ($Sb_2S_3$) layer, (denoted as TNTA-Ag/$Sb_2S_3$) was chosen for its suitable band gap position and high visible light response. Scanning electron microscopy (SEM) was used to study the surface morphology, while X-ray photoelectron spectroscopies (XPS) was employed to showcase the elemental composition of the synthesized photoanode. We have successfully demonstrated that $Ag^+$ ion doped TNTA/$Sb_2S_3$ shows a photocurrent density of 6.5 mA $cm^{-2}$ vs. RHE in 0.5 M $Na_2SO_3$ (pH ~ 9.5) under AM 1.5 G illuminations, which is almost 24 times and 1.8 times greater than that of the pristine TNTA and TNTA/$Sb_2S_3$ photoanodes, respectively. As per my knowledge, this is the highest phototresponse received and the first study has been carried out yet for TNTA-Ag/$Sb_2S_3$ photoanode in PEC water splitting applications. Moreover, the TNTA-Ag/$Sb_2S_3$ photoanode has shown the maximum Applied Bias Photon-to-Current Efficiency (ABPE) of 3.36%. It is suggested that the increased PEC performance of $Ag^+$ ion-doped TNTA/$Sb_2S_3$ is due to the enhanced conductivity of TNTA resulting from increased oxygen vacancies formed, the broad optical activity of $Sb_2S_3$, and reduced recombination of photogenerated charge carriers.

***Keywords:*** *PEC, Stibnite, TNTA Schottky junction*

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