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# Adsorption of Water on Cocatalyst Surfaces for Photocatalytic Water Splitting

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Photocatalytic water splitting is a promising technology for using solar energy to produce directly hydrogen (green hydrogen (GH2)), GH2 is considered to as environmentally friendly and renewable energy based fuel. However, only a few semiconductor materials have been developed as efficient photocatalyst, amongst them photocatalysts based on Al:SrTiO3.(1) A typical photocatalyst consists of three components: i) a semiconductor absorbing light and generating electron/hole pairs which migrate to ii) co-catalysts driving the hydrogen evolution reaction (HER) and oxygen evolution rection (OER) and iii) a protective overlayer blocking the reaction of the produced H2 and O2 back to H2O, i.e. blocking the backreaction. (2, 3) Co3O4 can be used as OER co-catalyst and Rh NPs as HER co-catalyst SrTiO3 (STO) while Cr2O3 as overlayer to block the backreaction. One of the questions which is not well understood is the contribution of the adsorption process of H2O onto the photocatalyst in driving the H2O splitting reaction. Does H2O adsorb as water onto the photocatalyst or does it turn into e.g. OH- as a first step in the H2O splitting process. In the present work this question is investigated. This question is investigated with electron spectroscopy. Firstly, X-ray Photo-electron Emission Spectroscopy (XPS) is employed as a common technique to investigate the chemical compositions of the surfaces including the adsorbates. Secondly, Metastable Induced Electron Spectroscopy (MIES), the most surface-sensitive technology for analyzing the surface, to determine the electronic structure and thus the molecular composition of the outermost layer. It was found with XPS and MIES that on STO (100) water partially dissociates forming OH- and H2O) on the surface. However, Rh NPs and Cr2O3 photodeposited on STO (100) resulted that only OH- was detected for both materials. These observations may support the Rh NPs and Cr2O3 rules to enhance the overall photocatalysis water splitting.

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