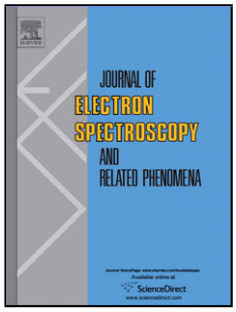

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Combined soft and hard X-ray ambient pressure photoelectron spectroscopy studies of semiconductor/electrolyte interfaces

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Abstract

The development of solar fuel generating materials would greatly benefit from a molecular level understanding of the semiconductor/electrolyte interface and changes in the interface induced by an applied potential and illumination by solar light. Ambient pressure photoelectron spectroscopy techniques with both soft and hard X-rays, AP-XPS and AP-HAXPES respectively, have the potential to markedly contribute to this understanding. In this paper we initially provide two examples of current challenges in solar fuels material development that AP-XPS and AP-HAXPES can directly address. This will be followed by a brief description of the distinguishing and complementary characteristics of soft and hard X-ray AP-XPS and AP-HAXPES and best approaches to achieving monolayer sensitivity in solid/aqueous electrolyte studies. In particular we focus on the detection of adsorbed hydroxyl groups in the presence of aqueous hydroxyls in the electrolyte, a common situation when investigating photoanodes for solar fuel generating applications. The paper concludes by providing an example of a combined AP-XPS and AP-HAXPES study of a semiconductor/aqueous electrolyte interface currently used in water splitting devices specifically the $BiVO_4$/aqueous potassium phosphate electrolyte interface.

Keywords: ambient pressure; photoelectron spectroscopy; solid liquid interface; HAXPES