Photolysis and Electrolysis for Solar Energy Conversion

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As the development of oxygen evolution co-catalysts (OECs) is being actively undertaken, the tailored integration of those OECs with nanostructured photoanodes is expected to be a plausible avenue for achieving highly efficient solar-assisted water splitting, yet hole transfer from a photoanode to water through the OEC layer is not still perfect. Here, we demonstrate that a black phosphorene (BP) layer, exfoliated from bulk BP, inserted between the OEC and BiVO4 can improve the photoelectrochemical performance of pre-optimized OEC/BiVO4 (OEC: NiOOH, MnOx and CoOOH) systems by 1.2~1.6-fold, while the OEC overlayer, in turn, can suppresses BP self-oxidation to achieve a high durability. A photocurrent density of 4.48 mA/cm2 at a bias of 1.23 V vs RHE under AM 1.5 illumination is achieved by the NiOOH/BP/BiVO4 photoanode; this photocurrent is 4.2 times higher than that of pure BiVO4 and 1.5 times higher than that of NiOOH/BiVO4. It is found that the intrinsic p-type conductivity of BP can boost hole extraction from BiVO4 and prolong holes trapping lifetime on BiVO4 surface. This work sheds light on the design of BP-based devices for application in solar to fuel conversion.