Unassisted Solar Water Splitting by Catalytic Multilayer Modified Photoelectrodes

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We report herein the development of fully solution-processable photoelectrochemical (PEC) cells for unassisted solar water splitting. PEC cells were composed of a n-type $BiVO_4$ photoanode and a p-type Cu_2O photocathode, which were modified with solution-processable catalytic multilayers by layer-by-layer (LbL) assembly. The catalytic multilayers consisted of cationic polyelectrolytes and anionic molecular electrocatalysts for hydrogen (HER) and oxygen evolution reactions (OER). After the deposition of the respective electrocatalysts, both photoelectrodes exhibited a significantly improved PEC performance due to the following reasons: (1) increased catalytic activity by catalyst-loading effect and (2) enhanced charge separation and transporting efficiency by interfacial dipole effect. In addition, the stability of the Cu_2O photocathode was unexpectedly and dramatically improved by the formation of the protective coating layer. As a result, we could successfully fabricate an efficient and stable PEC cell with simple solution processes. This study may provide a versatile platform for the design and fabrication of various electrochemical and PEC devices.