Hydrogen Generation by Photoelectrochemical water splitting using lithium doped bismuth vanadate photoanode

H_2 is being considered as one of the most potential fuels due to its highest gravimetric energy density among all the fuels. To realize economical way of producing H_2, the photoanodes should be of earth abundant materials through simple as well as scalable fabrication method. The major objective of the present study was to enhance PEC performance with complete suppression of charge recombination in bulk by doping lightest metal lithium in planar morphology $BiVO_4$. Li doped $BiVO_4$ with 2D planar morphology based photoanodes were prepared for improving charge separation efficiency along with enhanced light absorption by controlling the electrode thickness.

The Li doping has increased the light absorption, charge carrier density, mobility, electrochemical active surface area and lower trap state formation in such a way that near complete bulk charge separation in PEC process can be achieved. The IPCE measurements confirmed the extended and improved absorption in Li:$BiVO_4$ photoanode that lead to achieve theoretical photo current density. The impedance results showed that the Li doping has drastically reduced the bulk resistance, creating better charge mobility environment. As a result, the absorption, major charge carrier density as well as the major carrier mobility in Li doped $BiVO_4$ were significantly improved. Interestingly, the Li doped $BiVO_4$ photoanodes fabricated by a simple ultrasonic spray technic exhibited a record high charge separation efficiency of ~100 % with a corresponding PCD of 7.3 ± 0.36 $mA \cdot cm^{-2}$ at 1.23 V vs RHE in the presence of hole scavenger under one sun illumination.

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