High refractive index dielectric nanoparticles for optically-enhanced activity of water-splitting photoanodes

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Metal oxide semiconductors have shown considerable potential for photoelectrochemical water-splitting. However, no ideal material has emerged which benefit from both an attractive sunlight absorption and efficient charge transport properties. In this work, we show that decorating photoanodes with high refractive index nanoparticles such as amorphous titania can result in reduced reflection losses at the electrolyte/photoanode interface, thereby increasing the performances under illumina- tion from the electrolyte side. A proof of concept is obtained for a bismuth vanadate photoanode including a surface catalyst and a hematite photoanode. The photocurrent density and external quantum efficiency are improved by up to 10% upon nanoparticle decoration, quantitatively matching the decrease in reflectance. Simulations show that a similar enhancement happens when a thick bismuth vanadate photoanode with optimal charge transport properties is considered, thereby suggesting that this strategy can improve photoanodes suffer- ing from high reflection losses regardless of the bare sample performance.
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