Highly efficient type-II ZnTe@CdSe/CdSe hetero core/arm tetrapod structure quantum dot sensitizers for photoelectrochemical water-splitting

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Type-II core/shell quantum dot(QD) sensitizers have been extensively reported in the field of photovoltaics due to their superior optoelectronic properties such as fast charge separation, slow recombination. However, the efficiency of a cell is still limited by the slow charge transfer between QDs by hopping process and the low photo-voltage. To enhance the charge transfer efficiency and photo-voltage, ZnTe@CdSe/CdSe core@shell tetrapods are adopted and investigated as a sensitizer in the photo-electrochemical water-splitting system. The ZnTe@CdSe has fairly high the conduction band(CB) offset, which can increase the charge separation rate. Moreover, 1-D arms from the ZnTe@CdSe provide the direct electrical channel into TiO2, reducing the hopping process between QDs. In addition, charge accumulation across QD/TiO2 interface under illumination can induce the strong dipole moment, raising the CB of TiO2 upward resulting in the enhanced photo-voltage. We identified the superiority of the new type-II core/arm tetrapod in the construction of the water-splitting photo-anode. Carrier dynamics have been investigated through the PL decay and impedance spectroscopy.