Tin oxide as a photoanode for dye-sensitised solar cells: Current progress and future challenges

Qamar Wali, Azhar Fakharuddin, Rajan Jose,
Nanostructured Renewable Energy Materials Laboratory, Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, 26300 Kuantan, Malaysia

ABSTRACT

Tin oxide (SnO_2) is a candidate for applications requiring high electrical conductivity and optical transparency, such as a photoanode in dye-sensitised solar cells (DSSCs), due to its higher electron mobility and wider optical transparency than many other metal oxide semiconductors (MOS), such as TiO_2 and ZnO. However, DSSCs employing SnO_2 show significantly lower photoconversion efficiency, compared to that achieved by popular choices, such as $TiO_{2,}$ due to its intrinsic limitations such as lower conduction band energy and isoelectric point. A survey of literature shows a revived interest in SnO_2-based DSSCs, for example, strategies to (i) increase the dye uptake, (ii) increase its Fermi energy level, and (iii) reduce the recombination, such as by increasing surface roughness and novel morphologies towards (i), and doping of transition metals for (ii) and (iii). In response to these improvements, SnO_2-based DSSCs showed similar open circuit voltage and superior short circuit current to that achieved by TiO_2. We have undertaken a critical review on the progress made in overcoming the limitations and capitalising the advantages of SnO_2 to fabricate more efficient DSSCs. We identify that more investment is required to reduce the recombination in SnO_2 for it to emerge as an efficiency record holder in DSSCs.

KEYWORDS: Electrochemical properties of SnO2; One-dimensional SnO2; SnO2 composites; Doped SnO2 nanostructures; Core–shell SnO2 nanomaterials

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