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Nanostructured TiO_2 thin films sensitized by CeO_2 as an Inexpensive Photoanode for enhanced photoactivity of water oxidation

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Abstract:
Nanostructured CeO_2/TiO_2 bilayer thin films were fabricated by sequential deposition of CeO_2 on TiO_2 with varying the thickness of CeO_2 using sol–gel spin-coating method. All samples were characterized by XRD, SEM, and UV-Visible absorption spectroscopy with an inspiration to use them as photoanode in photoelectrochemical splitting of water. The CeO_2/TiO_2 bilayer with the optimized thickness of CeO_2 and TiO_2 showed enhanced photoelectrochemical response of 2.1 mA cm^{-2} at 0.95V/Ag/AgCl as compared to pristine CeO_2 and TiO_2. The improved photocurrent density of CeO_2/TiO_2 bilayer probably due to rapid transfer of charge carriers or electrical gradient at CeO_2/TiO_2 interface. This scalable and cost effective work with stable PEC performance of CeO_2/TiO_2 also shows the potential for realistic PEC applications.

Keywords: CeO_2/TiO_2, Bilayer, Photoelectrochemical response, Cost effective, Spin Coating.

Introduction:

Solar hydrogen generation by solar water splitting in PEC cells is the most forward-looking method in the recent time on account of hydrogen being widely accepted as clean energy carrier [1-2]. This solar-to-hydrogen conversion process initiated from the first PEC water splitting response of titanium dioxide (TiO_2) by Honda and Fujishima in 1972 [3]. Nowadays, TiO_2 is well known semiconductor as photoanode due to its suitable band positions, abundant, non-toxic, and stability. However, previous studies on TiO_2 have found that its wide band gap of 3.2 eV absorbs only UV part of the solar spectrum and high recombination rate of photogenerated electron–hole pairs due to its short diffusion length of charge carriers are main drawbacks that limited the photocatalytic activity and visible light response of TiO_2 [4-5]. In this regards, extensive surveys have been carried out on refining the photoelectrochemical response of TiO_2. Among the numerous techniques coupling of TiO_2 with other low band gap semiconductor with matching band edges positions will be potential method to improve the utilization of visible light and facilitation of photo-generated electrons