World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:13, No:03, 2019

Absorption and Carrier Transport Properties of Doped Hematite

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Abstract : Hematite (Fe2O3),commonly known as 'rust' which usually surfaced on metal when exposed to some climatic materials. This emerges as a promising candidate for photoelectrochemical (PEC) water splitting due to its favorable physiochemical properties of the narrow band gap (2.1–2.2 eV), chemical stability, nontoxicity, abundance, and low cost. However, inherent limitations such as short hole diffusion length (2–4 nm), high charge recombination rate, and slow oxygen evolution reaction kinetics inhibit the PEC performances of a-Fe2O3 photoanodes. As such, given the narrow bandgap enabling excellent optical absorption, increased charge carrier density and accelerated surface oxidation reaction kinetics become the key points for improved photoelectrochemical performances for a-Fe2O3 photoanodes and metal ion doping as an effective way to promote charge transfer by increasing donor density and improving the electronic conductivity of a-Fe2O3. Hematite attracts enormous efforts with a number of metal ions (Ti, Zr, Sn, Pt ,etc.) as dopants. A facile deposition-annealing process showed greatly enhanced PEC performance due to the increased donor density and reduced electron-hole recombination at the time scale beyond a few picoseconds. Zr doping was also found to enhance the PEC performance of a-Fe2O3 nanorod arrays by reducing the rate of electron-hole recombination. Slow water oxidation reaction kinetics, another main factor limiting the PEC water splitting efficiency of aFe2O3 as photoanodes, was previously found to be effectively improved by surface treatment.

Keywords : deposition-annealing, hematite, metal ion doping, nanorod
Conference Title : ICNMN 2019 : International Conference on Nanostructured Materials and Nanotechnology
Conference Location : Miami, United States
Conference Dates : March 11-12, 2019