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Facile Zn and Ni co-doped hematite nanorods for efficient photocatalytic water oxidation

In this work, we report the effect of zinc (Zn) and nickel (Ni) co-doping of hydrothermally synthesized hematite nanorods prepared on fluorine-doped tin oxide (FTO) substrates for enhanced photoelectrochemical (PEC) water splitting. Seeded hematite nanorods (NRs) were facile doped with a fixed concentration of 3 mM zinc and varied concentrations of 0, 3, 5, 7, and 9 mM of nickel. The doping of the hematite NRs had no noticeable impact on the surface morphologies of all the samples. They demonstrated a largely uniform topology of vertically aligned NRs with slight inclinations. The nanorods showed high photon absorption within the visible spectrum due to their bandgaps which ranged between 1.9 – 2.2 eV. The highest photocurrent density of 0.072 mA/cm2 at 1.5 V vs. RHE was realized for the 3 mM Zn/7 mM Ni co-doped NRs sample. This photocurrent was 279 % higher compared to the value observed for pristine hematite. The Mott-Schottky results reveal an increase in donor density values with increasing Ni dopant concentration. The 3Nm Zn/7mM Ni NRs and 3Nm Zn/9mM Ni NRs samples produced the second-highest and highest donor concentrations of 2.93 and 3.00 × 1019 (cm-3) respectively, which were at least 3.4 times higher than that of pristine hematite. This contributed to the highest photocurrent density obtained for the 3Nm Zn/7mM Ni NRs sample. This work demonstrated the role of Zn and Ni co-dopants in enhancing the photocatalytic water oxidation of hematite nanorods for the generation of hydrogen.

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YES

Level for award;(Hons, MSc, PhD, N/A)?

PhD

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