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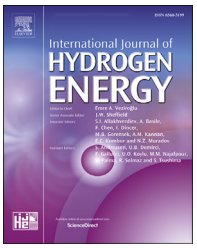

Influence of chromium and lanthanum incorporation on the optical properties, catalytic activity, and stability of IrO_x nanostructured films for hydrogen generation

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HIGHLIGHTS

- Pure, Cr-doped, and (Cr, La) codoped IrOx photoelectrodes are made by spin coating.
- The structural and morphological features of the photoelectrodes are studied.
- The performance of the photoelectrodes for solar H_2 production (HP) is evaluated.
- Cr, La and temperature affect optical and HP efficiency along with electrode stability.
- Conversion efficiencies, Tafel slopes, corrosion and thermodynamic parameters are obtained.

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ABSTRACT

Hydrogen production (HP) by photocatalytic water splitting (PWS) is becoming more and more popular on a global scale. The world's largest and most accessible renewable energy source—the Sun—as well as widely accessible metal oxide-based photoelectrodes are both utilized in this process. The preparation of pure and doped iridium oxide (IrO_x) films is attempted in this work in an effort to better understand how Cr and La affect optical and HP efficiency as well as electrode stability. By using FE-SEM, the films' varying thicknesses and nanorod-like morphologies were detected. UV–Vis spectra reveal that the composition has an impact on the films' absorption and reflectance. IrO_x has an optical band gap (E_g) of 2.9 eV, and this value decreased/increased after Cr doping/La codoping. The micro-Raman spectra, which showed that the E_g mode of Ir–O stretching was red-shifted from 563 to 553 cm^{-1}, validate the films' amorphous nature. The resultant (IrO_x) films were utilized in the HP via the solar photoelectrochemical (PEC) process. The codoped film, which has a solar-to-hydrogen conversion efficiency of 2.32% and a hydrogen evolution rate of 23.5 mmol $h^{-1}cm^{-2}$, is the most efficient and stable photoelectrode among the electrodes under examination. The highest absorbed photon-to-current conversion efficiency (APCE %) values for pure and codoped IrO_x photoelectrodes were 3.62%@460 nm and 5.54% @490 nm, respectively. With enhancement factors of 2.77, 1.89, and 2.90 for pure IrO_x, IrO_x:5% Cr, and IrO_x:Cr,2.5% La, respectively, the J_{ph} increased to 1.58, 1.70, and 1.83 mA cm^{-2} at 90 °C. After ten runs, the codoped photoelectrode still has 99.2% of its

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