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Optimization of processing parameters of dip coated CuO films for photoelectrochemical water-splitting

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Abstract.

In this work, thin films of dip coated CuO nanoparticles were prepared on fluorine-doped tin oxide (FTO) substrates and the film's processing parameters which includes the withdrawal rate, film thickness and annealing temperature were optimized for photoelectrochemical (PEC) water splitting. CuO films were prepared at withdrawal speeds ranging from 50-200 mm/min, with thicknesses of 158-627 nm and annealed at 400-650 ℃ for 1 hr. X-ray diffraction (XRD) and Raman spectroscopy studies confirmed the preparation of crystallized CuO films of high purity. The estimated crystal sizes for the films increases with withdrawal rate and annealing temperature, producing the highest value for films withdrawn and annealed at 150 mm/min and 600℃ respectively. The CuO films indicated strong optical absorptions in the visible region and their absorbance increases with increasing film thickness. The band gaps of all samples ranged from 1.69 to 2.08 eV. Linear Sweep Voltammetry (LSV) measurements yielded the highest photocurrent densities of 2, 2.6 and 2.9 mA/cm2 at 0.37 V vs RHE for films prepared at withdrawal speed of 150 mm/min, deposited with 7 layers and annealed at 600℃. The high photocurrent obtained for the films was due to the optimized film thickness, enhanced crystallization and the decrease in charge transfer resistance at solid/liquid interface achieved for the films. The least photocurrent was observed for films annealed at 400℃ due to poor crystallization and high charge transfer resistance obtained. This study emphasized the importance of optimizing processing parameters such as withdrawal speed, film thickness and annealing temperature in the preparation of CuO films for photocatalytic applications.

Keywords: CuO photocathodes, PEC water-splitting, withdrawal speed, film thickness, annealing temperature.

Apply to be considered for a student ; award (Yes / No)?

Yes

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MSc

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