Vacuum-Assisted SILAR Approach to Fabricate the CuInS2/TiO2 Nanotube Electrode with Enhanced Interfacial Charge Transfer Property

by

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Abstract

CuInS2/TiO2 n-n heterojunction nanotube arrays (NTs) electrode was synthesized via a vacuum-assisted successive ionic layer adsorption and reaction (SILAR) approach. Characterization results of morphology and crystalline properties confirmed the success of a large coverage of CuInS2 decoration onto TiO2 NTs with uniform structural features. The formed heterojunction was demonstrated as n-n junction by Energy Dispersive Spectroscopy (EDX), X-ray Photoelectron Spectroscopy (XPS) and Mott-Schottky analysis. The heterojunction exhibited an enhanced photocurrent density of 1.47 mA cm⁻² at 1.0 V vs. SCE and photoconversion efficiency of 1.60% at 0.6 V vs. SCE. Quantitative analyses of band gap structure and Mott-Schottky plots elucidated the interfacial charge transfer process and higher charge separation efficiency. In addition, a higher photocatalytic activity for the composite electrode was identified through ESR technique by comparatively investigating the generation of hydroxyl radical species on different samples. The excellent PEC and photocatalytic performances of CuInS2/TiO2 nanotube electrode were conclusively attributed to the following factors: (i) the uniform and dispersive decoration of CuInS2 contributing to the facilitated electron transfer; (ii) the extensive connection between CuInS2 and TiO2 by vacuum-assisted impregnation; (iii) the effective interfacial charge transfer and restraining recombination of photo-generated electron-hole pairs owing to a large area of heterojunction structure. This work demonstrated the validity of vacuum-assisted SILAR route to synthesize an n-n CuInS2/TiO2 heterojunction electrode.

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