Sacrificial Template Synthesis of Copper Tungstate: Influence of Preparing Conditions on Morphology and Photoactivity

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Morphology-controlled synthesis of ternary transition metal oxides is very important for their application in many fields. As a typical n-type semiconductor ternary oxide, CuWO₄ finds application in solar water splitting as a photoanode material. In this work, we successfully prepared the CuWO₄ nanoflakes (NFs), nanoneedles (NNs) and nanoparticles (NPs) films via a thermal solid-state reaction using different WO₃ as sacrificial templates. We systematically investigated the effect of the morphology, size, and crystal type of the WO₃ templates on the resulting CuWO₄. We found that the morphology and size of WO₃ templates and the reaction temperature were crucial factors that dominated the formation and morphology of CuWO₄. The well-crystallized CuWO₄ NFs and NPs were obtained at 550 °C, whereas, the crystalline CuWO₄ NNs could be obtained at a much lower temperature of 475 °C. All the obtained CuWO₄ samples exhibited activity and good stability for photoelectrochemical (PEC) water oxidation. Among the CuWO₄ samples, the NFs exhibited the highest activity, which was attributed to (1) the high light absorption efficiency obtained from the perpendicularly oriented NF structure and (2) the large electron density. This work reveals the dependence of morphology, crystallinity, and photoactivity of CuWO₄ on the preparation conditions during sacrificial template synthesis.

Keywords: Copper tungstate; Sacrificial template synthesis; Photoelectrochemical water splitting.

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