$CoWO_4$-based Oxygen-Evolving Catalysts for Electrochemical and Photoelectrochemical Water Oxidation

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Electrochemical and photochemical water splitting has drawn great attentions because it allows production of chemical fuels in carbon-neutral manner. However, water oxidation reaction acts as a rate determining step, requiring development of efficient water oxidation catalysts (WOCs) and simple strategy for their integration on the desired electrode surface. To address these issues, we developed a simple method to synthesize and integrate efficient WOCs for electrochemical and photoelectrochemical water oxidation. Simple heat treatment of cobalt-based polyoxometalate led to the formation of CoWO4 nanoparticles, of which the structure and catalytic activity can be controlled by varying annealing temperature. At 400 °C, it was converted to amorphous CoWO4 with a high catalytic activity. Besides, at above 500°C, crystalline CoWO4 was formed with a degraded catalytic activity. According to X-ray photoelectron spectroscopy and density functional theory analyses, a large amount of oxygen vacancies were generated at 400 °C, leading to the formation of a high population of Co2+ -Co2+ couples with an optimum interatomic distance for water oxidation.