$CoWO_4$-based Water Oxidation Catalyst Derived from Polyoxometalates

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We report herein the synthesis of $CoWO_4$-based water oxidation catalysts (WOCs) derived from cobalt-based polyoxometalate (CoPOM). CoPOM with a molecular formula of $Co_4(H_2O)_2(PW_9O_{34})_2]^{10-}$ is a well-known homogeneous WOC. For its versatile application, however, its integration with a heterogeneous electrode/photoelectrode is critically required. We found that CoPOM can be readily converted to more efficient $CoWO_4$-based catalyst and integrated with a substrate by simple annealing process. According to our results, $CoWO_4$ catalysts can have both amorphous and crystalline phase, depending on the annealing temperature. We found that amorphous $CoWO_4$ formed at a relatively low temperature has much higher catalytic activity than pristine CoPOM and crystalline $CoWO_4$. The performance was found to be closely related to the distance between the nearest cobalt ions. Based on these findings, we could fabricate both an anode and a photoanode for water oxidation by integrating $CoWO_4$ on the carbon felt electrode and Fe_2O_3 photoanode, respectively. We believe that our findings can suggest simple way to synthesize efficient and stable WOCs for enhanced PEC system to accelerate solar energy storage.