

Precipitating metal nitrate deposition of amorphous metal oxyhydroxide films for electrochemical water oxidation

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We report here a facile, one-step precipitating metal nitrate deposition (PMND) method to prepare amorphous metal oxyhydroxide films containing Fe, Co, and Ni as efficient electrocatalysts for water oxidation. The unique synthesis technique allows easy control of the metal composition over a wide range on various substrates. A series of unary and binary metal oxyhydroxides of 30 compositions are synthesized by PMND on fluorine-doped tin oxide substrate as electrocatalysts. The activity of the metal oxyhydroxide films is represented by a volcano plot as a function of a single experimental descriptor. The optimum compositions for binary metal oxyhydroxide are determined on various conductive substrates, and the best NFe (2:8) electrocatalyst on NF exhibits a water oxidation current density of 100 mA/cm² with only 280 mV of overvoltage. Finally, we demonstrate a tandem PV-electrolysis system by using a c-Si PV module with a power conversion efficiency of 13.71 % and an electrochemical cell composed of NFe (2:8)/NF anode and a bare NF cathode with a conversion efficiency of 71.8 %, which records a solar-to-hydrogen conversion efficiency of 9.84 %.