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Acidic Redox-assisted Deposition of Complex Metal Oxides Materials for Energy Applications: The Mechanism Study

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A technique developed by our team, called acidic redox-assisted deposition (ARD), will be presented to produce multi-metal oxide materials with high elemental homogeneity, improved conductivities, and durable stability. This talk will cover the nanostructured particles and thin films comprised of cobalt, iron, silver, cerium, and manganese oxides. The thin films demonstrate a strong adhesion on arbitrary substrates, including surfaces of plastics, metals, ceramics, and woods with complex surface textures. The ARD samples with a high continuity can be deposited with an ultrathin thickness (less than 10 nm) over a large area (5000 x 25 cm^2) in simple manners. The nanostructures and compositions of ARD can be controlled by varied reaction temperatures.

The ARD multi-metal oxides have been tested in an alkaline oxygen evolution reaction (OER), showing a comparable activity to the benchmark of RuO_2. The complex oxide deposition with more than four different metals has been conducted to show excellent stability against corrosion in seawater electrolysis. The film structures, redox reaction principle, and growth control mechanism will also be discussed. We also demonstrated this film to be highly antibacterial, active, and almost invisible. In addition, it is possible to use ARD film as an inorganic binder for water-splitting reactions. The detailed formation mechanism studied by X-ray absorption techniques will be discussed. This redox approach represents an unprecedented, generic protocol for creating new multi-metal oxide electrocatalysts on diverse electrode surfaces.

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