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Understanding the Role of Gold Nanoparticles in Enhancing the Catalytic Activity of Manganese Oxides in Water Oxidation Reactions

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Abstract:

The Earth-abundant and inexpensive manganese oxides (MnO_2) have emerged as an intriguing type of catalysts for the water oxidation reaction. However, the overall turnover frequencies of MnO_x catalysts are still much lower than that of nanostructured IrO_2 and RuO_2 catalysts. Herein, we demonstrate that doping MnO_x polymorphs with gold nanoparticles (AuNPs) can result in a strong enhancement of catalytic activity for the water oxidation reaction. It is observed that, for the first time, the catalytic activity of MnO_x/AuNP catalysts correlates strongly with the initial valence of the Mn centers. By promoting the formation of Mn^{3+} species, a small amount of AuNPs (<5 %) in α-MnO_2/AuNP catalysts significantly improved the catalytic activity up to 8.2 times in the photochemical and 6 times in the electrochemical system, compared with the activity of pure α-MnO_2.

Key-words: manganese oxide, metal nanoparticles, oxygen evolution reaction, transition-metal oxides, water oxidation