Highly Active, Nonprecious Metal Perovskite Electrocatalysts for Bifunctional Metal-Air Battery Electrodes

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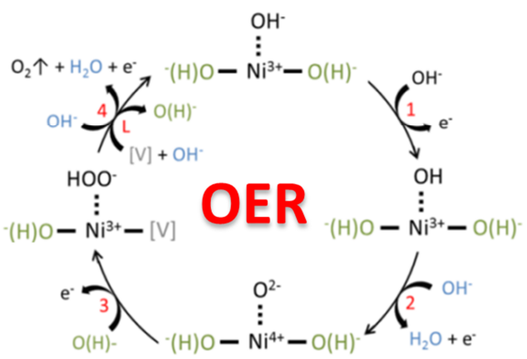
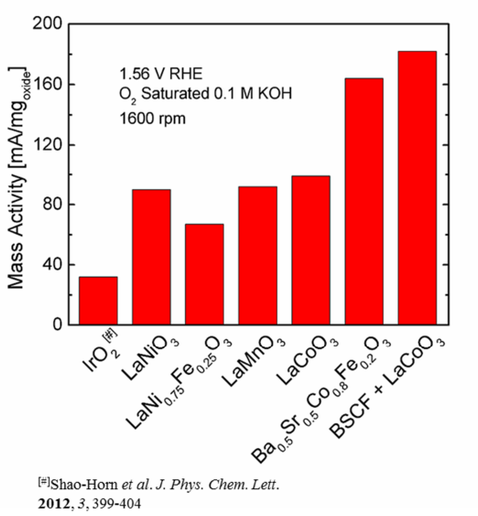
Perovskite catalysts are of great interest as replacements for precious metals and oxides used in the oxygen evolution reaction (OER) and oxygen reduction reaction (ORR). Perovskite electrocatalysts have been shown to have greater specific activities than precious metals and their oxides, but high mass activities have not yet been realized due to vague or incomplete mechanistic understanding of catalysts active sites coupled with inadequate synthesis techniques which often result in unwanted phase impurities and micron-scale materials. Herein, we demonstrated precise control over the synthesis of essentially phase pure perovskite nanocrystals with mass activities exceeding that of IrO_2 and possessing comparable or greater bifunctional character than leading precious metals such as Ir and Pt. The robust aqueous synthesis of ABO_3 perovskites such as $LaCoO_3$, $LaMnO_3$, $LaNi_xFe_{1-x}O_3$ and $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ will be demonstrated, and the resulting electrocatalytic activities of these materials will be presented. We will examine these results in the context of proposed perovskite activity descriptors, surface hydroxylation, oxygen vacancies and mechanistic pathways for the OER and ORR. Catalytic activity is determined using electroanalytical techniques such as rotating disk electrochemistry and cyclic voltammetry in conjunction with materials characterization enabled by dynamic light scattering, electron microscopy, nitrogen sorption, X-ray photoelectron spectroscopy and X-ray diffraction. It is demonstrated that these highly active perovskite catalysts are an emerging replacement for the precious metals used not just for the OER and ORR, but also for the chlor-alkali and oxygen depolarized cathode industries as well.





[#]Shao-Horn *et al. J. Phys. Chem. Lett.* **2012**, *3*, 399-404

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