Synergistic Development of Perovskite Oxide Electrocatalysts Through Metal-Organic Framework Precursors for Energy Conversion Applications

Alyousef, Abeer (School: Dohat Alibdaa International Schools)

The growing global energy demand and environmental concerns have highlighted green hydrogen as a promising solution due to its potential for clean energy production. Pursuing the exploration of new, efficient electrocatalysts for hydrogen production holds promise for sustainable and economical alternatives to noble metal-based counterparts. In this work, an innovative strategy that involves MOF precursors has been utilized for the fabrication of cost-effective perovskite oxides that enable high compositional flexibility. Compared to the traditional sol-gel technique for perovskite oxide synthesis, a novel one-pot method was employed. This involved the preparation of MIL-100(Fe) and ZIF-67 precursors, followed by calcination to successfully produce core-shell carbon-coated lanthanum-based perovskite oxides. Their characterization and formation were confirmed by PXRD and EDX. The developed MOF-derived perovskites displayed a higher specific surface area of 81.82 m2/g compared to 9.9 m2/g of the pristine perovskite. The electrocatalytic performance of the MOF-derived perovskites in LSV experiments surpassed that of the pristine perovskite by over 100%, even outperforming commercial IrO2 with an onset potential of 0.23 V at 10 mA/cm2. The electrochemical stability of the MOF-derived perovskites was tested for 7 hours, demonstrating excellent durability. This innovative synthesis methodology presents significant promise for the sustainable synthesis and development of various perovskite oxide electrocatalysts, addressing energy and environmental challenges.

Awards Won:
Second Award of $2,000
American Chemical Society: Fourth Award of $1,000