Transforming Zn-TAL metal-organic framework precursor into highly efficient electrocatalyst for oxygen reduction reaction

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Manufacturing efficient electrocatalysts for the oxygen reduction reaction (ORR) is crucial in advancing renewable energy technologies. Metal-organic frameworks (MOFs) are promising precursors to synthesize metal-nitrogen-carbon (M-N-C) catalysts with superior catalytic performance. While heat treatment is commonly employed to transform MOFs into electrochemically active M-N-C materials, maintaining their favorable structure during pyrolysis remains a challenge.

In this study, we address this challenge by investigating the role of pyrolysis in the design of MOF-derived catalysts. Inspired by earlier studies, which highlighted the limitations of conventional transition metal-doped MOFs due to agglomeration and graphitization issues, we focused on a novel approach using new Zn-based MOF.[1,2] Specifically, we report on the synthesis and optimization of a Zn-N-C electrocatalyst derived from Zn-TAL via optimized pyrolysis. Through a comprehensive analysis of the chemical and morphological evolution of Zn-TAL-derived materials using ex-situ techniques, we elucidate the transformation process during pyrolysis.

The optimized Zn-N-C catalyst exhibits ORR catalytic activity comparable to commercial Pt/C catalysts. Our results show significant potential of utilizing Zn-TAL as facile precursor for the fabrication of highly efficient electrocatalyst materials. This work not only contributes to advancing our understanding of the design principles for MOF-derived electrocatalysts but also demonstrates the viability of Zn-TAL-derived Zn-N-C catalysts as a promising alternative to conventional Pt-based catalysts for ORR applications.

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References

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