Boron Nitride Islands in Carbon Materials for Efficient Electrochemical Synthesis of Hydrogen Peroxide

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Summary

Co-doping of nanostructured carbon with boron and nitrogen has emerged as an attractive strategy to modulate the catalytic activity. However, limited experimental work has been done to systematically study these materials and much remains to be understood about the nature of the active site(s) and the factors underlying the activity enhancements of these boron, carbon and nitrogen (BCN) materials. Herein, we prepared several BCN materials experimentally with a facile method and systematically study their electrochemical performance with controlled synthesis. We demonstrated the existence of h-BN domains in the graphic structure for these materials using x-ray spectroscopy. These synthesized structures yielded higher activity and selectivity toward H₂O₂ than structures with individual B- or N-doping. We further employ density functional theory (DFT) calculations to understand the role of a variety of h-BN domains within the carbon lattice for the oxygen reduction reaction (ORR) and find that the interface between h-BN domains and graphene exhibits unique catalytic behavior that can preferentially drive the production of H₂O₂.

Synthesis

Characterization

Electrocatalysis Performance

Calculations

Applications