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Glucose-derived carbon supported well-dispersed CrN as competitive oxygen reduction catalysts in acidic medium

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Abstract

In this work, a glucose-derived carbon supported CrN composite is prepared by using a hydrothermal method and followed by a nitridating process. It is found that CrN nanoparticles in the composite are well-dispersed and separated by the carbon support. More importantly, the composite exhibits significantly enhanced oxygen reduction reaction activity than free-standing aggregated CrN nanoparticles, especially in acidic medium. The onset potential of the composite reaches 0.81 V in acidic medium, which is one of the highest values among the reported metal nitrides. The rotating ring disk electrode results indicate that the composite is more beneficial to O2 dissociation than free-standing CrN nanoparticles. Results of X-ray photoelectron spectroscopy, O2 temperature-programmed desorption and electrochemical impedance spectroscopy indicate that the significantly enhanced oxygen reduction reaction activity of the composite over free-standing CrN is derived not from the new formed active sites or enhanced oxygen adsorption but from the much enhanced electron transfer rate. This observation helps to understand the role of electron transfer rate playing in the oxygen reduction reaction activity of metal nitrides.