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In situ NAP-XPS and -SXAS study on the gas adsorption on Fe-N-C catalyst for oxygen reduction

Content

It is crucial to have a way to quantify the number of ORR active sites to evaluate the performance of electrocatalysts for oxygen reduction reaction (ORR). Strongly adsorbing gas molecules are useful as probes to identify the catalytically active sites and determine their surface density using various spectroscopic tools. This approach is rooted in the idea that chemically adsorbing gases such as CO, O2, or H2O may be attached selectively to the Fe centers of Fe-Nx ORR active sites. Based on this idea, there were some efforts to determine the number of Fe-Nx active sites by measuring the mass spectrum signals of gas molecules desorbed from Fe-Nx sites.

Here, we present the in situ XPS and SXAS results for gas adsorption (CO, O2) of Fe-N-C catalyst under near-ambient gas pressure to probe the ORR active sites. We could substantiate the environment necessary for the stable adsorption of gas molecules onto the Fe-N-C surface by controlling the gas pressure and sample temperature. With the NAP-XPS and -SXAS methods, we could detect the adsorbed gas molecules on the catalyst surface and corresponding chemical state change of Fe centers.

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