Boron and nitrogen co-doped carbon catalyst with acid-washing treatment for enhanced nitrogen electroreduction to ammonia

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Electrocatalytic synthesis of NH_3 under ambient condition is a promising process. And heteroatom doped carbon material is an effective catalyst[1]. In previous study, we prepared boron and nitrogen co-doped carbon (BNC) precursor catalyst by supramolecular pyrolysis process[2]. However, according to the characterization results, the surface of the prepared precursor catalyst had a high content of B_2O_3, and the performance of the catalyst was not ideal. We believed that surface B_2O_3 hindered the active site of the catalyst. In order to improve the catalytic performance of BNC material, B_2O_3 should be removed.

Therefore, in this work, the previously reported BNC precursor catalyst was acid-washed with H_2SO_4 to remove the surface B_2O_3 to prepare the BNC nanosphere catalyst. And the catalytic performance of BNC in different pH (pH=1, 8.3, 9.3, 13) electrolytes were investigated. It was found that the prepared BNC catalyst achieved a Faraday efficiency of up to 20% at -0.05 V vs. RHE in the mild alkaline electrolyte (0.5 M $KHCO_3$) with pH of 8.3, which was much higher than that in the acidic condition. We proposed the possible reaction model as shown in Fig. 1, where the interaction between OH^- and boron sites could effectively inhibit the adsorption and dissociation of H_2O, thus promoting the selectivity of NRR.

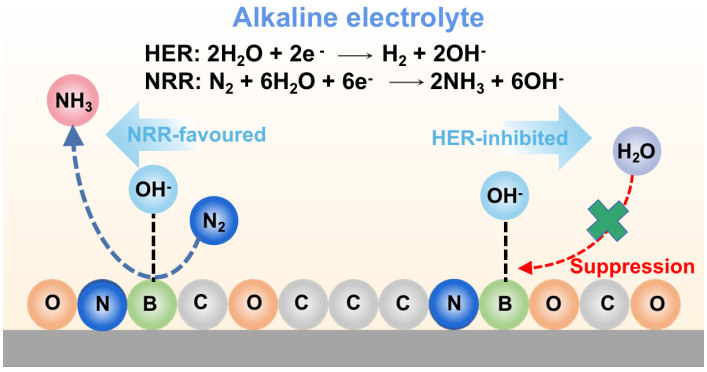

Fig.1 Reaction model of BNC catalyst in alkaline electrolyte

1) Wan, Y., Xu, J., & Lv, R. *Materials Today*, **2019**, 27, 69-90.

2) Wang, M. Fukunaga, A. **2022**. *The 102nd CSJ Annual Meeting, 25 March*, Tokyo.

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