Study on the catalytic performance of boron doped carbon-based catalyst in electrochemical nitrogen reduction

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Keywords: electrochemical nitrogen reduction; boron dopant; carbon-based catalyst

Electrochemical reduction of N_2 to NH_3 at the ambient condition is a promising alternative to the Haber-Bosch process. Carbon-based catalysts are widely used in electrochemical nitrogen reduction reaction, the introduction of heteroatoms can further improve the properties of carbon materials.[1)] In a pioneering work of Légaré et al., it was found that the boron atom of borylene molecular can fix N_2 molecules effectively and the dopant of boron introduces more defects.[2)]

In this study, boron doped carbon electrocatalysts were synthesized using the PEO-PPO-PEO triblock copolymers (F127) and boric acid though a controlled pyrolysis method. The catalytic performance of the catalysts analyzed under different pH electrolysis condition (KOH, $KHCO_3$ and HCl) at different reversible potentials. As shown in Fig.1, in neutral $KHCO_3$ electrolyte boron doped carbon electrocatalysts exhibited outstanding NRR performance with an ammonia yield of 19.0 μg h^{-1} $mg_{cat.}^{-1}$ at -0.40V (*vs*. RHE), and Faradaic efficiency of 11.9% at −0.10 V (*vs*. RHE) together with excellent stability. When the catalyst was in strong acid or alkali electrolyte, its catalytic performance and stability were lower than that in neutral electrolyte.

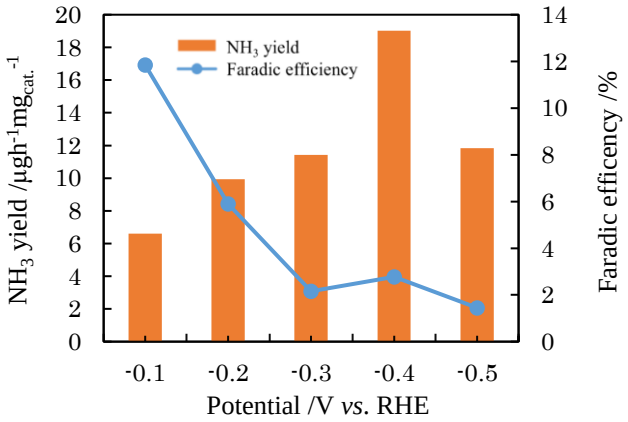

Fig. 1 NRR performance of boron doped carbon electrocatalysts in $KHCO_3$ electrolyte.

1） Kong, Xiang-Kai, Chang-Le Chen, and Qian-Wang, *Chen. Chem. Soc. Rev.* **2014**, 43, 2841

2） Légaré, Marc-André, et al. *Science.* **2018**, 359, 896

Acknowledgments: This study was partly supported by the "FY2021 Waseda University - ENEOS FS Research Grant".