Electrode development for nitrate reduction and ammonia production with Lithium mediated materials

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Ammonia is primarily manufactured by the century-old Haber-Bosch process, which runs at high temperature and high pressure. It is regarded as an important feedstock. In contrast, the electrochemical nitrogen reduction reaction (eNRR) has significant potential as a replacement for the Haber-Bosch process because it can produce ammonia at ambient conditions. Low Faradaic efficiency and a slow production rate, however, make it difficult to employ practically. Lithium-mediated eNRR has recently attracted considerable interest because of its outstanding performance and reproducibility. The inadequate understanding of the system's functioning, however, limits further advancement.

Here, we show that two chemical processes—dinitrogen splitting and protonation to ammonia—followed the electrochemical deposition of lithium to initiate the lithium-mediated eNRR.

Firstly, CeO_2 synthesis was performed in Ultra spray pyrolysis device. In the experiment carried out at high temperature (700°C), nano-sized powder material synthesis was performed. Then, by adding Lithium in different ratios (2-4-8-10%), material synthesis was carried out under the same conditions.
For electrochemical activity studies, electrodes were formed on glassy carbon with synthesized materials and nitrate reduction studies were carried out in neutral environment and H-Cell.
The characterization tests of the synthesized materials were completed. The results were compared with XRD, BET, SEM, FTIR tests. The solutions prepared by the indiphenol blue method were compared with the UV test and the amount of ammonia formation was tried to be determined.

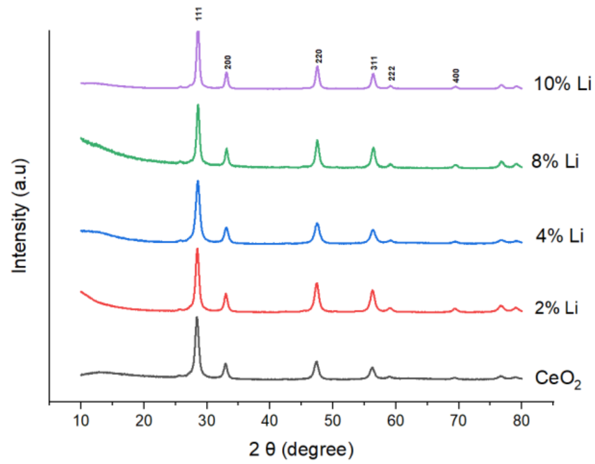

Figure 1. The histogram of XRD illustrating pure CeO2 and different concentration of Lithium added to CeO2 powder synthesis crystallographic orientations

According to the XRD results, as the lithium contribution is increased, the main peak shift is observed. It is observed that the CeO_2 character begins to change with the lithium effect.

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References

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