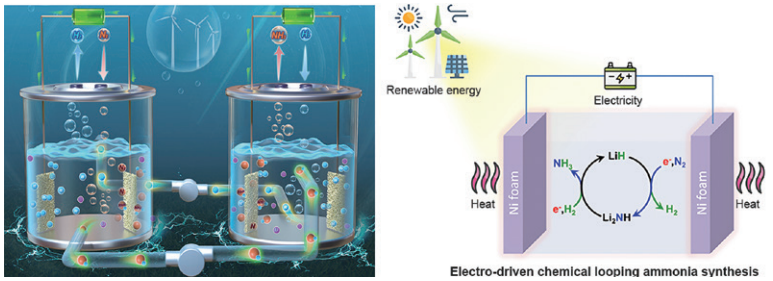
Basic Research

# Researchers Propose Electrodriven Chemical Looping Ammonia Synthesis Mediated by Lithium Imide

Ammonia ($NH_3$) is a promising energy vector for the storage and utilization of renewable energies. Artificially synthesizing $NH_3$ from its elements (Haber-Bosch process) requires harsh reaction conditions (400-500 °C, 10-30 MPa) because $N_2$ is inert and nonpolar with a strong N≡N bond. The synthesis of $NH_3$ under mild conditions is still challenging.




This electrodriven chemical looping ammonia synthesis (ECLAS) process is developed based on the conversion between LiH and Li2NH (Image by FENG Sheng and GAO Wenbo)

Recently, Assoc. Profs. CAO Hujun and GAO Wenbo and their collaborators from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) have proposed a new process for ammonia synthesis using $Li_2NH$ as an N carrier via the method of electrodriven chemical looping.

This study was published in *ACS Energy Letters* on February 23.

The researchers carried out this electrodriven chemical looping ammonia synthesis (ECLAS) in a LiCl-NaCl-KCl eutectic electrolytic cell using a nickel foam as electrode.

Electric energy input not only improved the hydrogenation rate of $Li_2NH$, but also promoted the nitrogen fixation reaction of LiH. In addition, the average ammonia production rate of this ECLAS process was nearly eight times higher than that of the thermal-driven CLAS process.

They found that the process contained two electrochemical reactions, one was the nitridation of LiH to form $Li_2NH$, and the other was the hydrogenation of $Li_2NH$ to produce ammonia and regenerate LiH. This was different from the reported $Li_3N$-mediated electrochemical ammonia synthesis process, which included three-step reactions: Li ion was reduced to Li, Li fixed dinitrogen to form $Li_3N$, and $Li_3N$ was then protonated to produce ammonia and $Li^+$.

"This ECLAS process has a low theoretical operating voltage than the $Li_3N$-mediated electrochemical ammonia synthesis process, and it could work under as low voltages as 2.0 V," said CAO.

"Our findings open new possibilities for developing electrodriven CLAS over imides," said CAO.

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(Source: DICP)

**Reference**

Feng, Sheng, Gao, Wenbo, Guo, Jianping, Cao, Hujun, & Chen, Ping. (2023). Electrodriven Chemical Looping Ammonia Synthesis Mediated by Lithium Imide. *ACS Energy Letters, 8*(3), 1567-1574. doi:10.1021/acsenergylett.2c02730