Docket #: S23-448

Eco-friendly method that produces ammonia, hydrogen peroxide, and methanol for value added products

Researchers within the Zare Lab, Department of Chemistry, have developed an eco-friendly, low cost, and simple method to produce inorganic small molecules (ammonia, hydrogen peroxide, oxygen, etc.) and short-chain organics (methanol, formic acid, ethane, etc.) through contact electrocatalysis.

The current production standard for fertilizer, the Haber-Bosch process, accounts for 2% of total global energy, requires high pressure and high temperature situations, and contributes 1% to carbon dioxide emissions in the atmosphere. In contrast, this new process stirs humidified air, suspended polytetrafluoroethylene (PTFE) or silica particles, and nitrogen gas to produce ammonia at room temperature. This less specialized technique does not use toxic chemical precursors, substantially reduces carbon dioxide emissions, and requires less energy than is consumed in the Haber-Bosch process. In addition, the method is suitable for the synthesis of short-chain organics (less than three carbons) and inorganic small molecules.

Stage of Development

- Proof of Concept

Figure 1:

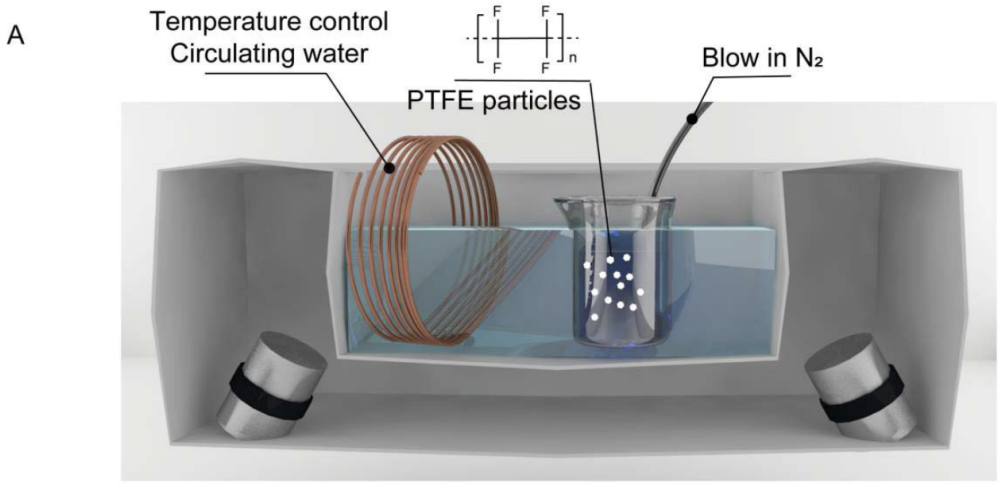

Figure description: Schematic representation of the experimental setup, synthesizing ammonia (NH_3) by bubbling nitrogen (N_2) gas into bulk liquid water containing polytetrafluoroethylene (PTFE) particles suspended with the help of a surfactant at room temperature.

Image credit: https://doi.org/10.1073/pnas.2318408121

Applications

- Ammonia production for fertilizer
- Methanol production
- Hydrogen peroxide production
- Formic acid production
- Oxygen production
- Ethane production
- Methane production

Advantages

- Low cost
- Less energy intensive
  - Uses humidified air instead of H_2 as the proton source for ammonia production
- Eco-friendly
  - Removes the need for toxic precursors, no carbon dioxide emissions

Publications

- Li, J., Xia, Y., Song, X., Chen, B., & Zare, R. N. (2024). Continuous ammonia synthesis from water and nitrogen via contact electrification. *Proceedings of the National Academy of Sciences, 121*(4), e2318408121.

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