Docket #: S22-335

Eco-friendly method that produces ammonia and urea for fertilizer and other uses

Stanford researchers at the Zare Lab, Department of Chemistry, have developed a simple and eco-friendly method that could potentially produce substantial amounts of ammonia and urea, both of which are primarily used in fertilizer.

The current production standard, the Haber-Bosch process, requires high pressure and high temperature situations, and produces large amounts of carbon dioxide emissions. In contrast, this new method utilizes water microdroplets, nitrogen gas in the case of ammonia and nitrogen gas and carbon dioxide in the case of urea each using a different solid catalyst which can be operated without application of an external voltage (no electrochemistry) and without application of external radiation (no photochemistry). This less specialized process substantially reduces carbon dioxide emissions and requires less energy than is consumed in the Haber-Bosch process in making ammonia.

Stage of Development
Proof-of-Concept

Hadhazy, Adam. New method for making ammonia could take a bite out of global energy use. *Stanford Report* (2023).

Applications

- **Ammonia production for Fertilizers** - Current annual worldwide demand is 150 million metric tons of ammonia. The Haber-Bosch process consumes more than 2% of global energy and accounts for about 1% of the carbon dioxide emitted into the atmosphere.

Advantages

- **Environmentally friendly-** Does not require fossil fuels and thus does not emit carbon dioxide
- **Lower cost:** Does not require high pressure and high temperatures
- **Energy efficient**
- **Simplified process-**
- **On-site production of ammonia/urea**

Publications

- Song, Xiaowei, Chanbasha Basheer, and Richard N. Zare. "Making ammonia from nitrogen and water microdroplets." *Proceedings of the National Academy of Sciences* 120, no. 16 (2023): e2301206120.
- Hadhazy, Adam. New method for making ammonia could take a bite out of global energy use. *Stanford Report* (2023).

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