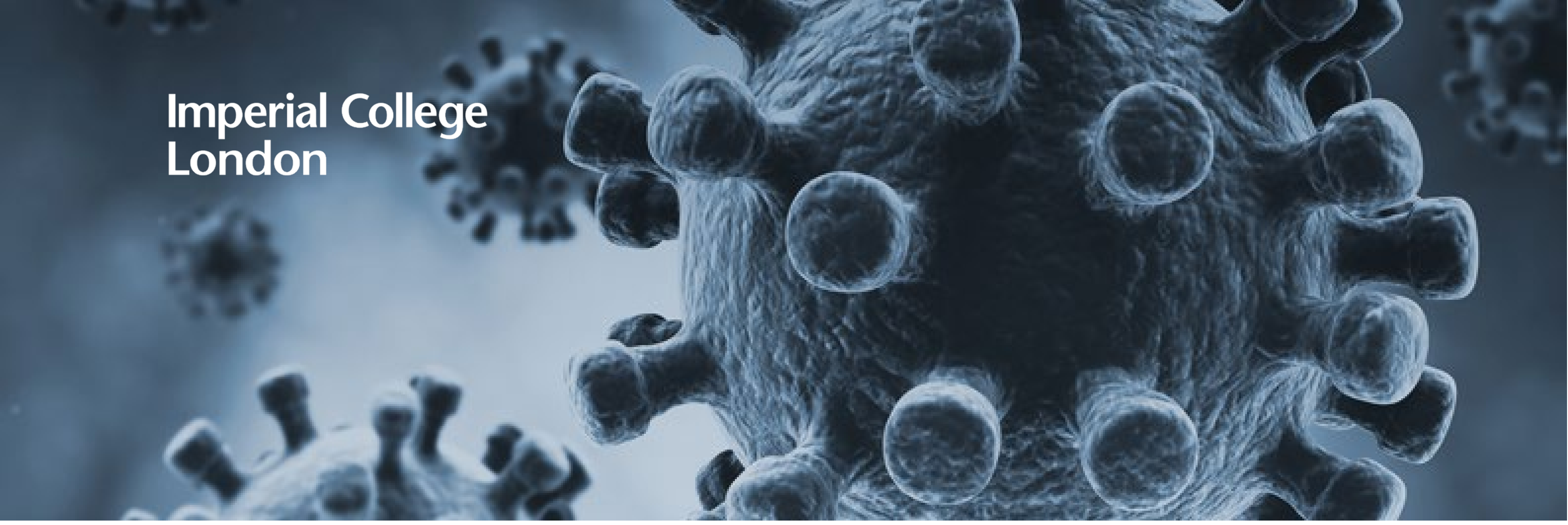

Hydrogenation of nitrogen for the synthesis of ammonia

Improved process for synthesizing ammonia under ambient conditions significantly reducing energy requirements and carbon emissions.

Proposed use

Ammonia is a valuable source of nitrogen which has been fundamental for plant growth and is a key component in fertilisers. In 2020, the global market for ammonia is estimated at US$63.7B, growing at a CAGR of 5.9% to reach US$89.6B by 2026. More than 80% of ammonia produced is used in fertilisers.

In addition to fertilisers, the production of green ammonia would eliminate the carbon footprint typically associated with the conventional method for synthesizing ammonia. If sustainable energy is used to power all aspects of its synthesis, ammonia can be made sustainably using only air, which is around 78% nitrogen, and water.

Problem addressed

Currently, synthesis of ammonia is predominantly achieved through steam reforming of methane to produce hydrogen which is fed into ammonia synthesis via the Haber Bosch process. Ammonia production currently accounts for around 1.8% of global carbon dioxide emissions and is significantly the largest CO_2 emitting chemical industry process. This is attributed to the high temperature (~500°C) and pressure (~20MPa) required for the process.

By reducing the energy requirements inherent with the Haber Bosch process for synthesizing ammonia, it would better enable the commercial viability of the production of green ammonia. This would lead to its use in broader applications, such as a zero-carbon fuel source and energy carrier. Burning ammonia as fuel results in the release of nitrogen gas as a waste product as opposed to greenhouse gases.

Technology overview

The technology relies on the use of specific catalysts to enable the necessary reaction for the synthesis of ammonia to occur under ambient conditions, i.e., at or below room temperature and at atmospheric pressure. The use of the widely-available catalysts can be further developed to demonstrate synthesis of ammonia at commercial scale without harmful waste products.

Intellectual property

Patent: US20210284673A1; EP3861003A1

Published paper

Ashley AE, Doyle LR, Hill PJ, Wildgoose GG, 2016, Teaching old compounds new tricks: efficient N2 fixation by simple Fe(N2)(diphosphine)2 complexes, *Dalton Transactions*, Vol: 45, Pages: 7550-7554, ISSN: 1477-9226

Inventor information

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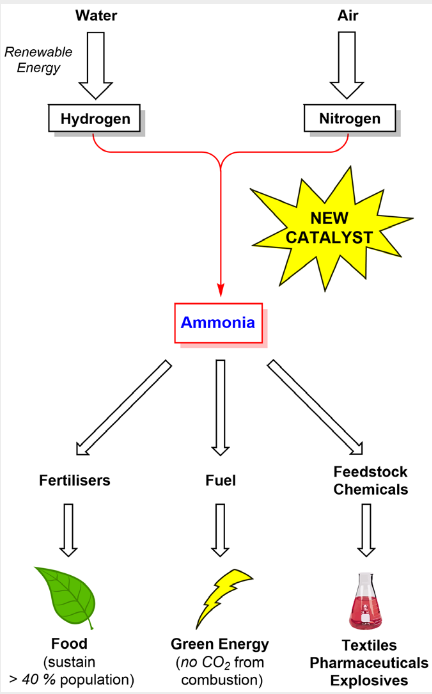
Benefits

- Reduced capital and operational costs compared to the Haber Bosch process as the improved process occurs under ambient conditions.
- Significantly reduced CO2 emissions as high temperature and pressures do not need to be maintained for its synthesis.
- Coupled with sustainably-produced or renewable hydrogen, the process enables a more commercially viable means for producing green ammonia.



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Technology reference: **8703**