PRESS RELEASE

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Tokyo Institute of Technology research: Development of highly active and stable ammonia synthesis catalyst under low temperatures

Profs. Hosono, Hara, Kitano, Abe and Dr. Inoue found that ruthenium nanoparticles immobilized on calcium amide ($Ca(NH_2)_2$) function as an efficient catalyst for ammonia synthesis at 300°C and the catalytic activity is more than 10 times higher than that of the highest performance Ru catalysts reported so far. In addition, 3% Ba-doped $Ca(NH_2)_2$ supported Ru catalyst exhibited excellent stability during reaction for 700 h (almost 1 month).

Ammonia is mainly consumed as a fertilizer in crop production and has attracted much attention as a promising candidate for a hydrogen carrier. The present findings will significantly promote the development of the energy-saving processes of ammonia synthesis. Commonly, most of Ru catalysts are supported on metal oxides or carbon materials. In the present catalyst, flat-shaped Ru nanoparticles with a uniform size distribution are distinctly anchored on the surface of $Ca(NH_2)_2$ by strong Ru−N interaction. As a result, Ru-loaded $Ca(NH_2)_2$ exhibits high catalytic performance and long term stability for ammonia synthesis under low reaction temperatures.

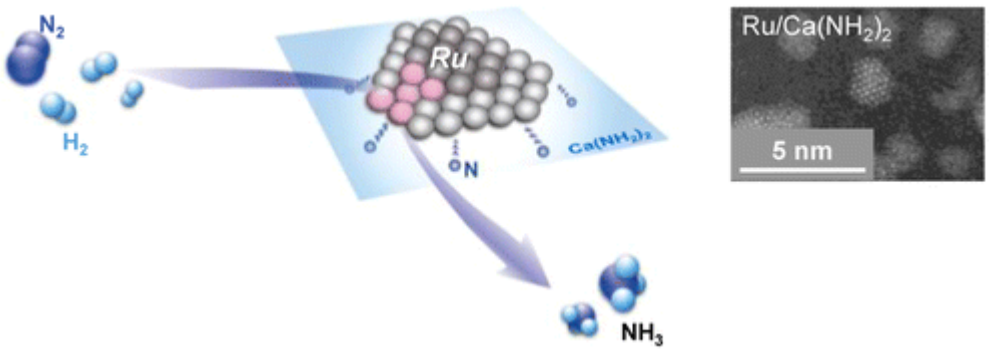

Figure.
Conceptual diagram of ammonia synthesis activity at low temperature micro-pressure conditions using a catalyst with a fixed ruthenium on calcium amide (left).
Electron microscopic image of the catalyst fixed ruthenium calcium amide (right).

Reference

Yasunori Inoue, Masaaki Kitano, Kazuhisa Kishida, Hitoshi Abe, Yasuhiro Niwa, Masato Sasase, Yusuke Fujita, Hiroki Ishikawa, Toshiharu Yokoyama, Michikazu Hara, and Hideo Hosono. "Efficient and Stable Ammonia Synthesis by Self-Organized Flat Ru Nanoparticles on Calcium Amide"*ACS Catalysis*, 6, 7577–7584 (2016), doi: 10.1021/acscatal.6b01940

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