websites of note

by Zoltan Nagy

Synthesis of Ammonia Directly from Air and Water at Ambient Temperature and Pressure

The N≡N bond (225 kcal mol^{-1}) in dinitrogen is one of the strongest bonds in chemistry, therefore artificial synthesis of ammonia under mild conditions is a significant challenge. Based on current knowledge, only bacteria and some plants can synthesise ammonia from air and water at ambient temperature and pressure. Here, for the first time, we report artificial ammonia synthesis bypassing N_2 separation and H_2 production stages. A maximum ammonia production rate of 1.14×10^{-5} mol m^{-2} s^{-1} has been achieved when a voltage of 1.6 V was applied. Potentially this can provide an alternative route for the mass production of the basic chemical ammonia under mild conditions. Considering climate change and the depletion of fossil fuels used for synthesis of ammonia by conventional methods, this is a renewable and sustainable chemical synthesis process for future.

- Rong Lan, John T. S. Irvine, and Shanwen Tao (Department of Chemical and Process Engineering, University of Strathclyde, Glasgow G1 1XJ, UK)
  http://www.nature.com/srep/2013/130129/srep01145/full/srep01145.html

Electrocatalysis Research for Fuel Cells and Hydrogen Production

The CSIR undertakes research in the electrocatalysis of fuel cells and for hydrogen production. The Hydrogen South Africa (HySA) strategy supports research on electrocatalysts due to their importance to the national beneficiation strategy. The work reported here presents choice methods for the production of Platinum Group Metals (PGM) electrocatalysts, which are characterized for their performance. Investigations on the commercial feasibility of such electrocatalysts in fuel cells including hydrogen production continue to be subject of global interest, to ensure energy security. The paper aims to present possible synthesis routes for PGM electrocatalysts for commercial gains.

- M. K. Mkhulu (HySA Infrastructure Center of Competence, Materials Science and Manufacturing, Council for Scientific and Industrial Research (CSIR), PO Box 395; Pretoria 0001; South Africa.)
  http://www.sciencedirect.com/science/article/pii/S1876610212014671

Electrochemical Synthesis of Ammonia in Solid Electrolyte Cells

Developed in the early 1900s, the "Haber–Bosch" synthesis is the dominant NH_3 synthesis process. Parallel to catalyst optimization, current research efforts are also focused on the investigation of new methods for ammonia synthesis, including the electrochemical synthesis with the use of solid electrolyte cells. Since the first report on Solid State Ammonia Synthesis (SSAS), more than 30 solid electrolyte materials were tested and at least 15 catalysts were used as working electrodes. Thus far, the highest rate of ammonia formation reported is 1.13×10^{-8} mol s^{-1} cm^{-2}, obtained at 80 °C with a Nafion solid electrolyte and a mixed oxide, $SmFe_{0.7}Cu_{0.1}Ni_{0.2}O_3$, cathode. At high temperatures (>500 °C), the maximum rate was 9.5×10^{-9} mol s^{-1} cm^{-2} using $Ce_{0.8}Y_{0.2}O_{2-\delta}$–$[Ca_3(PO_4)_2$–$K_3PO_4]$ as electrolyte and Ag–Pd as cathode. In this paper, the advantages and the disadvantages of SSAS vs. the conventional process and the requirements that must be met in order to promote the electrochemical process into an industrial level are discussed.

- L. Garagounis, et al. (Department of Chemical Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece)
  http://journal.frontiersin.org/article/10.3389/fenrg.2014.00001/full

About the Author

Zoltan Nagy is a semi-retired electrochemist. After 15 years in a variety of electrochemical industrial research, he spent 30 years at Argonne National Laboratory carrying out research on electrode kinetics and surface electrochemistry. Presently he is at the Chemistry Department of the University of North Carolina at Chapel Hill. He welcomes suggestions for entries; send them to nagyz@email.unc.edu.