Technology offer:
Versatile reforming catalyst for hydrogen production

Steam reforming of natural gas, sometimes referred to as steam methane reforming (SMR) is the most common and least expensive method of producing commercial bulk hydrogen as well as the hydrogen used in the industrial production of ammonia. At high temperatures, typically 850 – 950 °C and in the presence of a metal-based catalyst, steam reacts with methane to yield carbon monoxide and hydrogen. ECN has developed a new catalyst that is more stable and works and works at temperatures as low as 450 °C. This technology enables cost savings and opens the door to low-temperature steam reforming processes.

Key words: Steam Reforming; SMR; catalyst; hydrogen; H_2; methane; CH_4; natural gas; syngas; membrane reactor, SEWGS

Description
- ECN has developed a versatile catalyst for the production of hydrogen by steam (methane) reforming. The catalyst combines high activity and stability, potentially resulting in a significant longer lifetime and lower replacement frequency than current state-of-the art catalysts.
- The catalyst suites a wide range of reforming reaction conditions without the need to alter conventional catalyst production facilities.

New and innovative aspects
- A smart combination of metals and metal oxides together with nickel creates synergy and offers a higher conversion activity at lower temperatures and improved stability at higher temperatures compared to conventional nickel based catalysts.
- Low temperature reforming processes previously required expensive catalysts based on precious metals.

Main advantages of its use
- Renders the use of separate catalysts for high and low temperature reforming obsolete.
- For conventional (high temperature) reforming: cost savings through lower replacement frequency.
- For unconventional (low temperature) reforming: high catalytic activity and less expensive than precious metal based catalysts.

Specifications
- Catalyst combines aluminium oxide and preferably magnesium oxide, boron (B) and nickel (Ni). The presence of B aids the suppression of carbon formation and improves stability. The activity of the catalyst may be further enhanced by addition of promotors, i.e. precious metals such as Rh, Ru, Pd, Ir or Pt or base metals such as Sn, Cu, and Fe. These added promotors will aid the reduction of Ni and improves low temperature steam reforming efficiency. Average pore sizes are up to 20 nm. Pore size will direct the synthesized Ni particle size toward its highest activity in hydrogen production and lowest carbon formation activity. In parallel the pores prevent excessive sintering of Nickel.

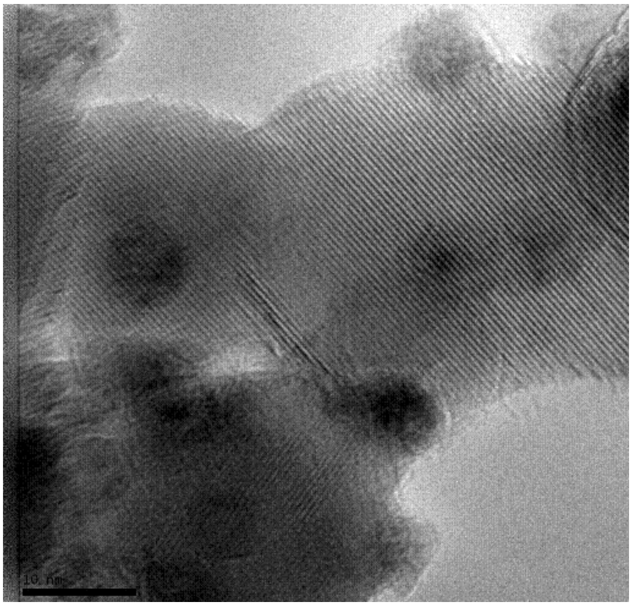

Figure 1: Microscopic image of a supported Nickel – Boron catalyst. The nickel particles are visible as darker spots, sizing up to 7 nm

Potential applications
- High temperature conventional reforming
- Seperation-enhanced reforming
- Low temperature convective reforming
- Pre-reforming

State of development
- Lab-scale testing under wide range of conditions (T, Steam to Carbon ratios).

Transaction type and partner profile
- Preferred transaction: license agreement
- ECN is looking for a business partner with sufficient know-how and track record to further develop the catalyst and successfully demonstrate it in an industrial setting. We are also interested in end-users who would like to work with us on a future pilot or demo project.

Publications and IP

- Ligthart, D.A.J.M., Pieterse, J.A.Z., Hensen, E.J.M. (2011) Applied Catalysis. A, General, 405, 108-119.
- WO2012067505

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