STEAM REFORMING OF BIOGAS IN A FLUIDIZED BED MEMBRANE REACTOR FOR PURE HYDROGEN PRODUCTION

N.C.A. de Nooijer[a], J. Melendez[b], E. Fernandez[b], D.A. Pacheco Tanaka[b], M. van Sint Annaland[a], F. Gallucci[a],

[a]Eindhoven University of Technology, Department of Chemical Engineering and Chemistry, Eindhoven, The Netherlands

[b]Tecnalia Energy and Environment Division. Mikeletegi Pasealekua 2, 20009San Sebastián-Donostia, Spain

Technische Universiteit Eindhoven University of Technology

Multiphase Reactors Group
Department of Chemical Engineering & Chemistry

Biogas as a fuel for hydrogen

The increasing demand for hydrogen and the potential for hydrogen in the energy system puts the emphasis on the development of a sustainable process for the production of hydrogen, in particular from a renewable source. Biogas is one of the renewables that could be utilized as alternative for natural gas in the production of hydrogen.

Project

This work aims to apply ceramic supported Pd-based membranes in a fluidized bed membrane reactor (FBMR) for the production of pure hydrogen from biogas.

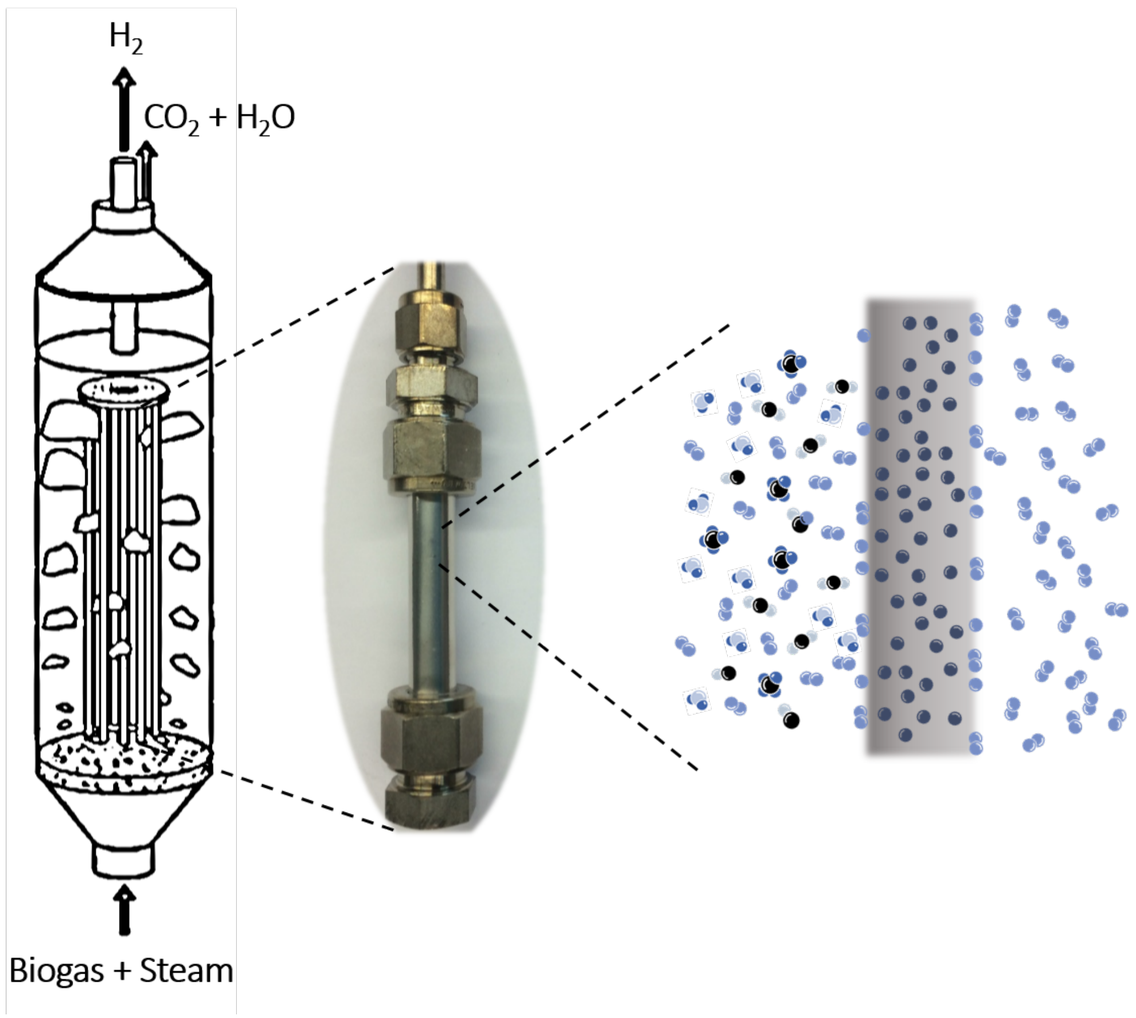


Figure 1. Schematic representation of the FBMR, picture of a sealed membrane, schematic representation of hydrogen diffusion through the palladium based membrane.

Membrane performance at high temperature

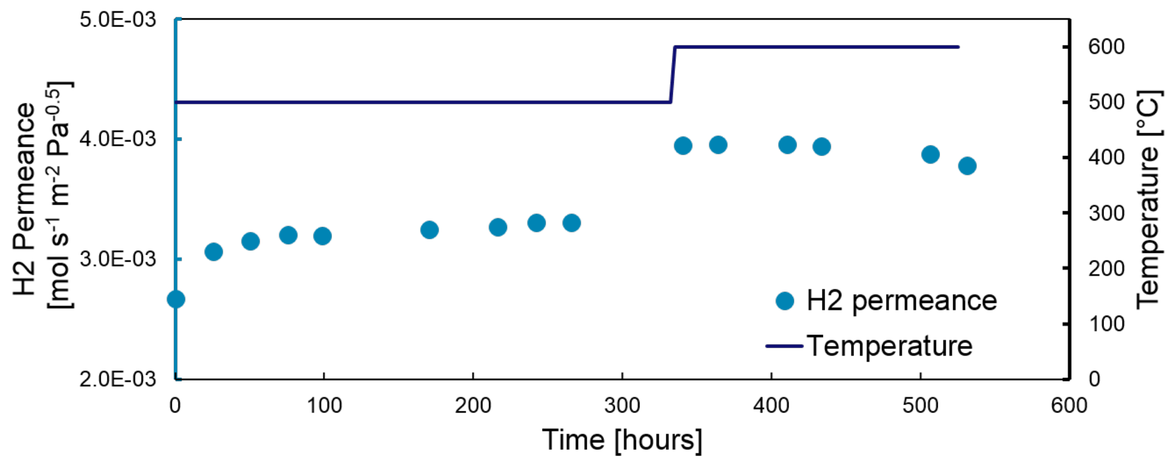


Figure 2. Long-term hydrogen permeance stability at 500°C and 600°C at 3 bar pressure difference for a PdAg Al_2O_3 supported membrane

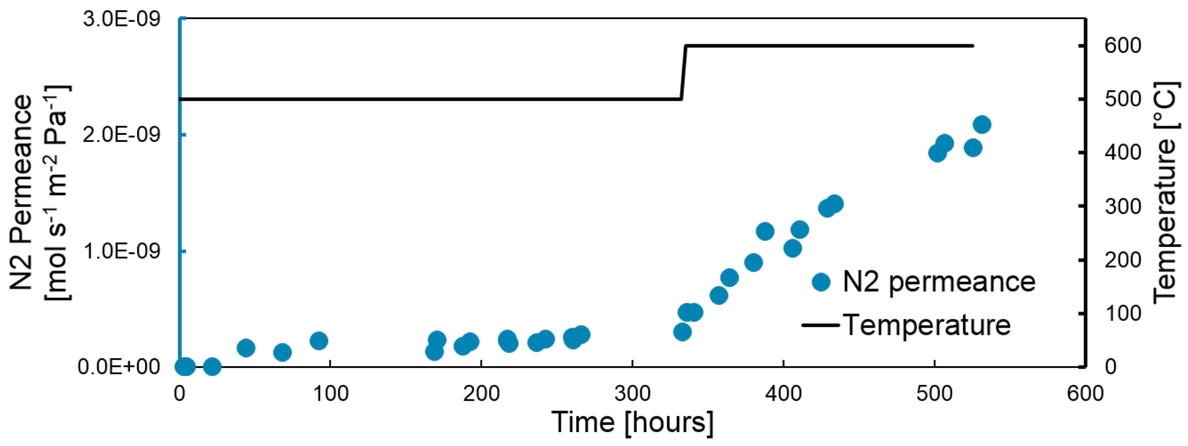


Figure 3. Long-term nitrogen permeance stability at 500°C and 600°C at 3 bar pressure difference for a PdAg Al_2O_3 supported membrane

Reactor Concept

The FBMR concept integration reaction and separation in a single unit. The selective removal of hydrogen through the membrane at reactive conditions results in a shift of the equilibrium, resulting in increased hydrogen yield. Moreover decreases the operating temperature and removes the necessity for down stream purification. However the integration of biogas in the FBMR concept is not without challenges.

Increasing H2S poisoning resistance of palladium based membranes

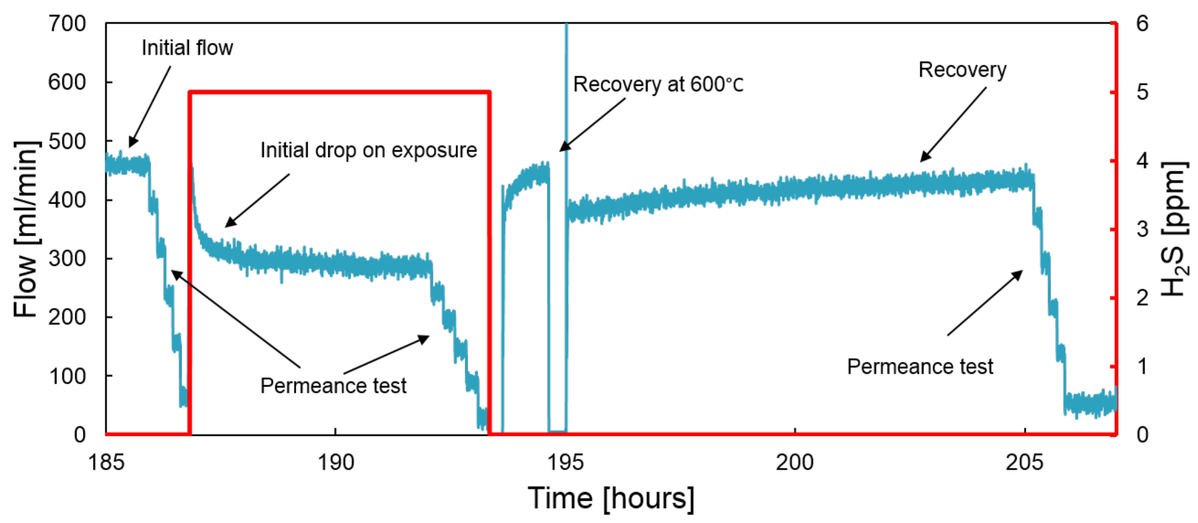
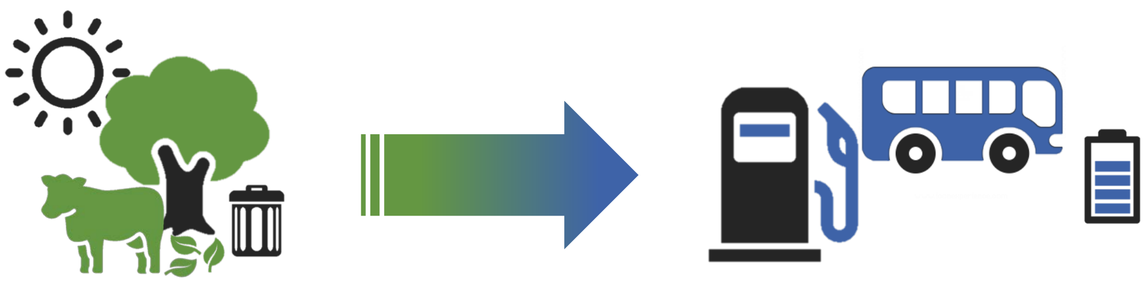


Figure 4. Exposure of 5 ppm H_2S on PdAgAu Al2O3 supported membrane at 550°C



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 671459 (BIONICO). This Joint Undertaking receives support from the European Union's Horizon 2020 research and innovation programme and Italy, Spain, Netherlands, United Kingdom, Germany, Portugal, Switzerland.