H2 PRODUCTION IN A PALLADIUM- BASED MEMBRANE REACTOR

Nora Buggy[1], Simona Liguori[1,2], Bryce Anzelmo[2], Jennifer Wilcox[1,2]

[1]Department of Chemical and Biological Engineering, Colorado School of Mines, Golden, CO
[2]Department of Energy Resources Engineering, Stanford University, Stanford, CA
nbuggy@mines.edu

One possible use for hydrogen, without direct greenhouse gas emissions, is as feed for a fuel cell (FC), with the most readily available technology being a proton exchange membrane FC (PEMFC). In order to avoid the poison of PEMFC's Pt-based catalyst due to the presence of ppm levels of CO, the hydrogen feed needs to be ultra-pure. The industrial process for hydrogen production, which is a multi-step energy intensive process followed by further separation/purification, can be a potential source [1]. However, as an alternative method a Pd-based membrane reactor (MR) can be used owing to its ability to provide the pure hydrogen without any further purification. Moreover, the MR works at milder operating conditions compared to the traditional system.

In the last years, Pd-based composite membranes, i.e. thin metallic layer supported on such porous materials as ceramics or stainless steel, have been considered owing to their lower cost (thin Pd layer) and higher mechanical resistant (porous support) than dense Pd-based ones [2]. Therefore, the aim of this study is to analyze the potentialities of a Pd membrane supported on porous stainless steel (PSS) with the intent to produce pure hydrogen from methane steam reforming.

The initial characterization of the membrane by way of ideal selectivity took place at 400°C with H_2, He and N_2 and □P in the range of 1.5 - 3.0 bar. After ideal selectivity characterization of the Pd/PSS membrane, methane steam reforming reaction is carried out in MR by varying reaction pressure and sweep gas flow rate.

The best performance of the Pd-based MR is obtained at 400 °C, 3.0 bar and 100 mL/min of sweep-gas, yielding a methane conversion of 84%, hydrogen recovery of 82%, and obtaining a pure hydrogen stream at the permeate side.

REFERENCES

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