MEMBRANE SUPPORTS DESIGNED FOR PD MEMBRANES

Olivia Barron, HySA Systems Competence Centre, South African Institute for Advanced Materials Chemistry, University of the Western Cape
oliviachanel.barron@gmail.com
Bernard Jan Bladergroen, South African Institute for Advanced Materials Chemistry, University of the Western Cape
bbladergroen@uwc.ac.za
Cordelia Sita, HySA Systems Competence Centre, South African Institute for Advanced Materials Chemistry, University of the Western Cape
Vladimir Linkov, South African Institute for Advanced Materials Chemistry, University of the Western

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Unique properties such as high permeance and a theoretically infinite selectivity to hydrogen gas exhibited by Palladium (Pd)-based membranes have caused thin Palladium films to emerge as an attractive method to separate and purify hydrogen from syngas. Pd-based membrane costs are a considerable economic hindrance to transforming this technology into a commonly applied gas separation technology, hence, the cost of these membranes needs to be reduced significantly. Cost reduction can be achieved by utilising composite membranes, composed of a thin dense layer of a Pd alloy deposited onto a porous support structure. While significant research has focused on Pd-based top layer optimisation, the physical properties of each sublayer have all but been ignored. In order to address challenges such as stability and durability of membranes, membrane production and operation costs more effectively, the current work aims to look at each layer as an integral part of the membrane system instead of unlinked individual layers.

The end product of Pd-based membrane development should exhibit the following characteristics; a) defect-free continuous films, without protruding defects which would negatively affect the quality of the collected permeate gas, b) mechanically and chemically stable films, to hinder the formation of defects during the lifetime of the membrane under operating conditions, c) the film should have minimum thickness required in order to obtain a) and b) as excessive thickness will have a detrimental impact on H_2 permeance and material cost.

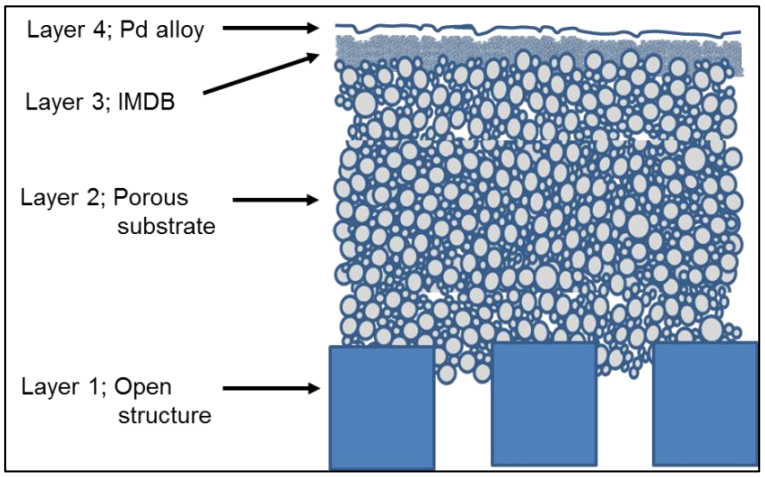

Figure 1 – Schematic representation of a multi-layered support including the Pd alloy membrane.

These criteria can be successfully met by depositing a Pd alloy onto a support consisting of several layers [1, 2]. Figure 1 illustrates the schematic representation of a multi-layered support including the Pd alloy. Each layer effectively connects and influences the function of the adjacent layer, and without a proper understanding of the interaction between the various layers, the production of a Pd-based membranes with the appropriate durability, selectivity and permeability is virtually impossible.

A custom multi-layered support structure with pore size distribution using a Porolux 1000 and gas permeation results will be presented during the conference.

References

[1] S. N. Paglieri, J. D. Way, Sep. Purif. Methods 31, (2002) 1-169.
[2] S. Fletcher, (2009). Thin film Palladium-Yttrium membranes for Hydrogen Separation (PhD thesis, The University of Birmingham, Birmingham, United Kingdom)