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Simple tool based on MatchCAD software for transient gas permeation modeling and experimental data processing in fuel cell membranes
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Up until recently measurements of gas permeability (steady-state and transient) in polymeric membranes have mostly been a
focus of research in the membrane gas-separation community. Most of the permeability results were obtained for dry single
gases or binary gas mixtures across an ambient temperature range to reflect typical operation conditions in gas separation
modules and/or packaging films.
PEM fuel cells are expected to operate at much wider temperature range (-40°C to 120°C) and various humidity levels. These
conditions are not typical for most gas permeability experiments. Lack of data for oxygen, nitrogen and hydrogen permeability
constants in various polymeric materials suitable for use as PEM under elevated temperatures and various humidity levels
requires further research.
Measuring permeability constants at different relative humidity levels also presents an experimental challenge that would be
typically avoided in traditional gas permeation experiments. Permeability of gases in membranes under operation conditions
existing in a PEM fuel cell has thus become one of the key properties that require comprehensive research.
Extensive experimental methods, procedures and mathematical treatments have been developed for both steady- state and
transient measurements with focus on non proton-exchange membranes (PEM) that are typically have homogeneous nature. In
the latter case transient experimental gas-permeation data could be used adequately for processing by using classical
mathematical solutions obtained for a second Fick's law under appropriate boundary conditions.
When diffusion of gases takes place in a highly heterogeneous, multilayered, or chemically active membranes, mathematical
processing of transient experimental data remains a challenge.
Some of the issues mentioned above will be discussed in further details including a proposal to use method of statistical
moments to process transient gas-permeation data and some experimental results on gas permeability modeling in PEM will be
presented in this paper. First- and second-order boundary conditions for diffusion equations were also discussed in this poster.
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Technology, December Issue, 2007, pp. 6-9