Heat and mass transfer visualization in microfluidic water electrolyzers

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Abstract

Water electrolysis has been proposed as a carbon-neutral fuel storage solution by converting water into hydrogen and oxygen gas through the consumption of electricity. Polymer electrolyte membrane water electrolyzers (PEMWE) in particular have become particularly attractive due to their high current density operation and wide range of operating conditions. Many polymer electrolyte membrane parameters (e.g. hydration, swelling) have been studied, but the relationship between these parameters and heat/mass transfer remains unclear.

In this work, heat and mass transport in a microfluidic PEMWE is characterized through a combination of Fourier transform infrared (FTIR) spectrometer with an infrared (IR) camera. FTIR spectroscopy coupled with IR spectroscopy enable visualization of the heat and mass transfer in the channels and membrane of the microfluidic PEMWE through multi-physical fields. Heat and mass transport models of this system are created to compare and validate experimental results. Results from this work can be used to enable further membrane developments and influence future electrochemical reactor designs.