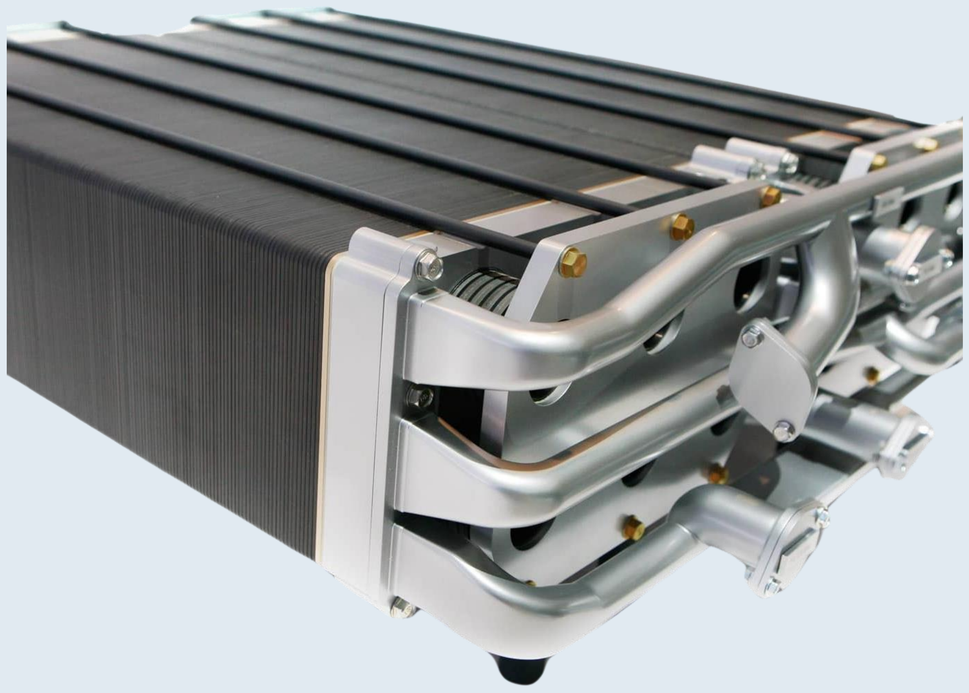

3D, two-phase multispecies transport model of PEM Fuel Cell

The transport of liquid water through the flow channels and membrane electrode assembly (MEA) of the PEM fuel cell is studied and analyzed.

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Introduction

The Water management is a central issue in proton exchange membrane (PEM) fuel cell. The polymer electrolyte membrane required sufficient water to exhibit a high ionic conductivity. The water molecules in fuel cell operation, moves through the membrane under electro-osmotic drag, convection, diffusion etc.

To overcome the early transport resistances, gases are humidified. On the other hand, water is also generated as byproduct from the electrochemical reaction.

The removal of excess water is required from electrodes and gas channels, which clogs the pores of electrode and reaction is hindered.

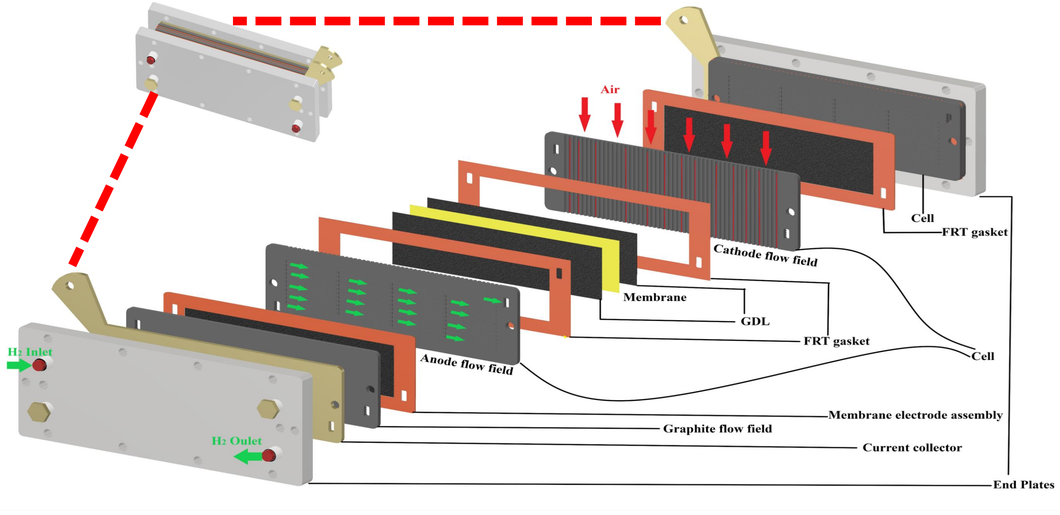

FIGURE 1. CAD representation of fuel cell stack, components, and flow of reactant gases through channels.

Methodology

To study the transport of water, condensation and evaporation phenomenon in anode and cathode domains are solved using temperature dependent vapor pressure.

The reactant gases enters the flow channels in laminar flow and liquid in dispersed phase, with additional mass transport source from porous gas diffusion layer, governed by eqn. 1.

$$m = k\left(c_{channel} - c_{porous\ media}\right)M \qquad (1)$$

k- mass transfer rate; c-concentration; and M- molecular wt.

Results

The proposed work, as illustrated in Figure 2 concludes that-

- Higher concentration of liquid water saturation at the outlet than at the inlet.
- Water accumulation at the edges of channel are observed near the outlet area.
- For anode catalyst layer, membrane, cathode catalyst layer the trend of liquid water saturation is in increasing order.
- The water saturation level is highest in the cathode catalyst layer, followed by gas diffusion layer and micro porous layer.

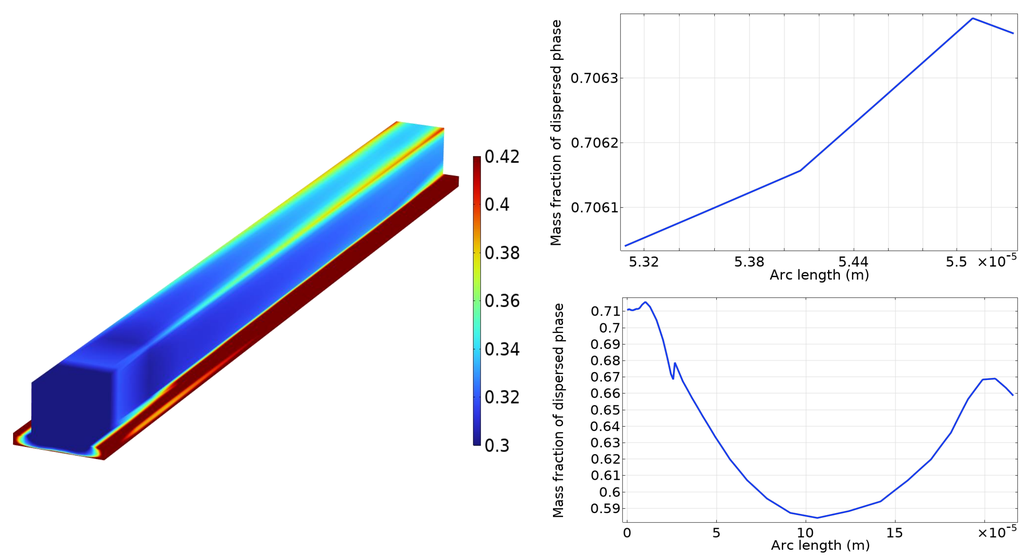

FIGURE 2: Visualization of liquid water content within different domains of PEM fuel cell.

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