251c Dynamics of Ignition and Front Propagation in Polymer Electrolyte Membrane Fuel Cells

Jay B. Benziger, I.G. Kevrekidis, and E.-S. J. Chia

The stirred tank reactor polymer electrolyte membrane (STR-PEM) fuel cell exhibits remarkable steady state multiplicity analogous to the autocatalytic exothermic stirred tank reactor. The dynamics in the STR-PEM fuel cell are the result of a unique balance between water production and water removal within the cell. Ignition and extinction of the fuel cell current is controlled by the temperature, flow rate and external load resistance of the fuel cell. The STR-PEM fuel cell is used as a building block to approximate more conventional integral (plug flow) type fuel cell reactors. By connecting several STR-PEM fuel cells in series, the effects of the four operating parameters (temperature, external load resistance, inlet hydrogen and inlet oxygen flow rates) on the current evolution along the flow channel of a fuel cell can be monitored. Ignition and extinction fronts propagate along the flow channels of PEM fuel cells, moving from end to end with co-current flow and from center to end with counter-current flow. We will show experimental data and model predictions of the ignition and extinction front movements in PEM fuel cells.