



SAND2019-11106C

Numerical Modeling of Emergency Hydrogen Refueler for Fuel Cell Electric Vehicles

Skyhaven CRADA Project

PRESENTED BY

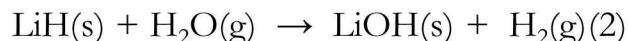
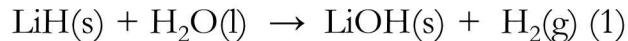
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Multiphysics Numerical Model Developed at Sandia National Labs

Goal: develop a robust Multiphysics numerical model of the Skyhaven refueler which will be used to improve the performance of current refueler prototype.

- Chemical Reactions:



- Reaction Rates

$$r_1 = k_1 [\text{LiH}]^{n_1} [\text{H}_2\text{O(l)}]^{m_1}$$

$$r_2 = k_2 [\text{LiH}]^{n_2} [\text{H}_2\text{O(g)}]^{m_2}$$

$$r_3 = A \sqrt{\frac{2}{\pi MRT}} \frac{1}{2-c_c} \left(C_e p_0 \exp \left(\frac{L}{R} \left(\frac{1}{T_b} - \frac{1}{T} \right) \right) x_{liq} - C_c p(T) x_{vap} \right)$$

- System of equations solved for a reacting two-phase flow in a porous media

- Conservation of Mass Equations

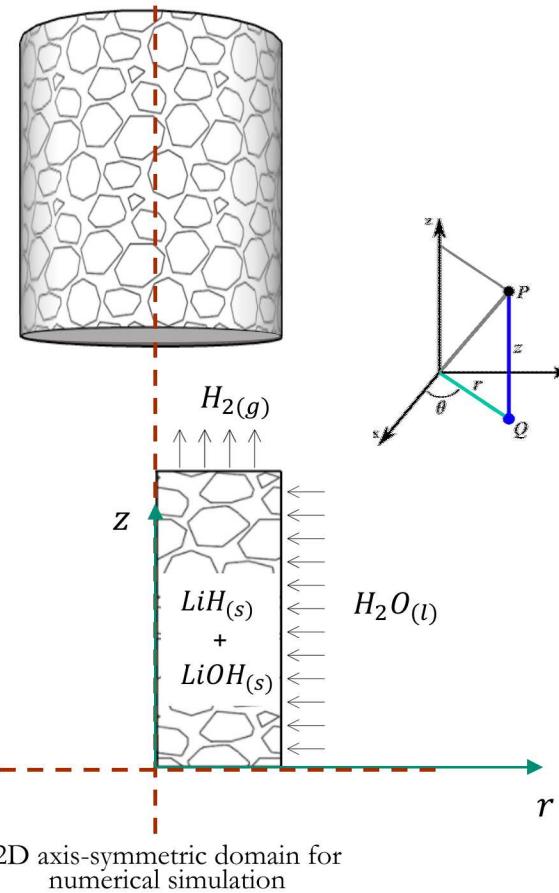
- Solid phase
- Gas phase
- Liquid phase

- Conservation of Chemical Species

- Solid Phase
- Gas Phase

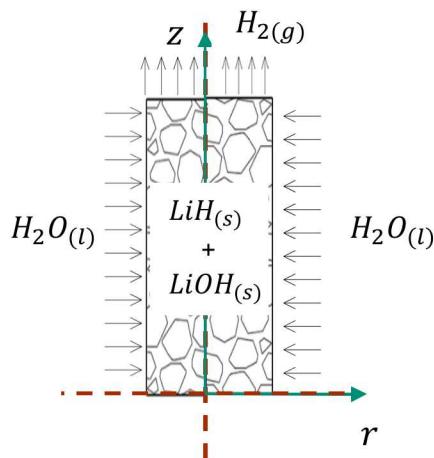
- Conservation of Energy

3D refueler with a single cell unit



Preliminary Results from Numerical Simulations

- Numerical simulations can capture the reduction in hydrogen generation as LiOH forms and bed permeability reduces



- Future work
 - Validate results with Skyhaven's experimental data
 - Perform parametric study to improve performance design

