391c Membrane Reactor Design for Thermally Balanced Hydrogen Production

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Hydrogen production by steam reforming of methane or methanol in a catalytic fixed bed membrane reactor was theoretically investigated. Hydrogen separation by a permselective inorganic membrane (e.g., Pd) shifts the equilibrium of the stem reforming reaction. The endothermicity of the steam reforming is compensated by the combustion of methane or methanol. Two alternative designs for the thermal coupling of endothermic steam reforming and exothermic oxidation were compared. The steady and transient simulations investigated the influence of various operation parameters and specifically were aimed to determine the boundary (of feed temperature, concentration) that will allow adiabatic operation. Since thermal fronts are formed axial dispersion cannot be ignored. The simulations show that the thermally balanced reactor may be operated without heating. The reactor is designed to provide high purity hydrogen feed for fuel cells. Laboratory tests are currently under design. Comparison with other approached, like millisecond combustion will be discussed.