Partial oxidation of methane coupled with CRM and SRM in a tubular membrane reactor: a CFD simulation study

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Abstract

A CFD model for oxygen permeation and partial oxidation of methane (POM) to syngas in a La0.6Sr0.4Co0.2Fe0.8O3-δ tubular membrane reactor was adopted to investigate the effects of the methane space velocity (MSV) and the feed composition on the reactor performance. It is shown that coupling POM reaction with carbon dioxide and steam reforming of methane (CRM and SRM), which is realized by co-feeding CH4 with CO2, H2O or CO2-H2O mixture into the reactor, can significantly enhance the methane conversion and syngas production rate and alter the H2/CO ratio as compared with feeding CH4 alone. For co-feeding CH4 with CO2, H2O or CO2-H2O mixture, the maximum syngas production rate is 2.3, 2 and 1.8 times that of feeding CH4 alone. Also, when POM is coupled with CRM and SRM, the temperature inside the reactor can be maintained above 973 K which is required for proper functioning of the membrane and catalyst.

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