519d Autothermal Methane Reforming in a Reverse-Flow Reactor

Tengfei Liu, Hakan Temur, and Goetz Veser

Autothermal methane reforming (ATR) is an alternative process to steam reforming of methane (SRM) for synthesis gas and/or hydrogen production. By combining an exothermic oxidation reaction with endothermic steam reforming in one reactor, ATR meets the intensive energy demand in conventional SRM and thus allows autothermal reactor operation. However, even ATR runs into autothermal limitations if the water-to-oxygen feed ratio is increased to optimize hydrogen production.

We have previously demonstrated that regenerative heat integration in a reverse-flow reactor (RFR) can overcome autothermal limitations in catalytic partial oxidation of methane (CPOM) and leads to strongly increased syngas yields. Here, we extend our studies onto ATR over Ni catalysts in a RFR.

Our results demonstrate that regenerative heat integration can indeed strongly increase the range of autothermal operation for ATR towards increased CH4:H2O feed gas ratios. RFR operation thus not only yields significantly improved hydrogen and syngas yields in comparison to SS operation, but also allows for much higher H2/CO ratios in the product stream. Improvements in conversion are particularly pronounced for very high flow rates (i.e. very short contact times), which makes the ATR-RFR process particularly well suited for compact reactors and hence for small-scale and decentralized hydrogen production.