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Mid-Temperature Methane-Based Chemical Looping Reforming for Hydrogen Production via Iron-Based Oxygen Carrier Particles

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Abstract : Hydrogen is an ideal and potential energy carrier due to its high energy efficiency and low pollution. An alternative and promising approach to hydrogen generation is the chemical looping steam reforming of methane (CL-SRM) over iron-based oxygen carriers. However, the process faces challenges such as high reaction temperature (>850 ℃) and low methane conversion. We demonstrate that Ni-mixed Fe-based oxygen carrier particles have significantly improved the methane conversion and hydrogen production rate in the range of 450-600 ℃ under atmospheric pressure. The effect on the reaction reactivity of oxygen carrier particles mixed with different Ni-based particle mass ratios has been determined in the continuous unit. More than 85% of methane conversion has been achieved at 600 ℃, and hydrogen can be produced in both reduction and oxidation steps. Moreover, the iron-based oxygen carrier particles exhibited good cyclic performance during 150 consecutive redox cycles at 600 ℃. The mid-temperature iron-based oxygen carrier particles, integrated with a moving-bed chemical looping system, might provide a powerful approach toward more efficient and scalable hydrogen production.

Keywords : chemical looping, hydrogen production, mid-temperature, oxygen carrier particles
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