Pt-Calcium-Cobaltate Enables Sorption-Enhanced Steam Reforming of Glycerol Coupled with Chemical Looping CH4 Combustion

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Abstract

As an efficient approach to high-purity hydrogen, the sorption-enhanced steam reforming (SESR) is usually highly energy-intensive. Herein, the sorbent decarbonation was conducted in the presence of O2 to enable the exothermic reaction between CaO and cobalt oxides to form calcium cobaltate (CCO). By utilizing CCO as oxygen carrier (OC), the chemical looping methane combustion (CLMC) was employed prior to the SESR of glycerol (SESRG). The CCO was pre-reduced to generate a multi-functional material composed of metallic Co catalysts and CaO sorbent, which can significantly improve the H2 yield from SESRG. With a simple Pt-doped CCO acting as pre-catalyst, CO2 sorbent and OC, we realized 70% CH4 conversion and 96 vol.% H2 with 120% yield for 20 cycles. The promoting effects of Pt towards CH4 conversion and H2 production were rationalized by CH4-TPR, XPS, SEM and TEM. Our results demonstrate the feasibility of process integration and intensification enabled by multi-functional materials.

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