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PROCEEDINGS

CH_4 conversion into value-added products by catalytic processes assisted by electrochemical reactions in solid oxide cells

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Methane (CH_4), the major constituent of natural gas and biogas, is an abundant source to obtain value-added hydrocarbons. The oxidative coupling of methane (OCM) is a direct catalytic route to convert CH_4 towards C_2 hydrocarbons (C_2H_6 and C_2H_4). The use of electrochemical devices such as solid oxide fuel cells (SOFC) as a reactor for OCM is possible, providing synergistic control of electrochemical oxidation/reduction reactions to energy production with in-situ catalysis [1]. In this context, the use of mixed oxide $La_{0.5}Ce_{0.5}O_{2-\delta}$ (LCO) was studied as an additional catalytic layer on the Ni/YSZ anode of a SOFC for the operation under CH_4 as fuel. The presence of surface oxygen vacancies in single-phase LCO, which may benefit the OCM reaction, was evidenced by Raman spectroscopy [2]. The catalytic properties of LCO at 800 ºC were investigated in a fixed-bed catalytic reactor, resulting in a C_2 selectivity and yield of 41% and 8%, respectively. The modified SOFC with the additional LCO-catalytic layer was fabricated and tested under H_2 and CH_4 [2]. The electrochemical properties were studied during online gas analysis of the anode outlet. The experimental data revealed that CH_4 conversion and product distribution are closely related to operational conditions such as reactant concentration, anode feed flow rate, current output, and operating temperature. In addition to C_2, products of internal methane reforming (CO and H_2) were detected in all evaluated conditions. The SOFC showed stable behavior, maintaining a stable current of 20 $mA \cdot cm^{-2}$, 10% of CH_4 conversion, and 14% of C_2 selectivity throughout 30 h. The combined catalytic and electrochemical reactions described are considered a promising approach to producing valuable chemicals and electrical energy.

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References:
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