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ABSTRACT:

High Active Monolithic Catalysts for Electrified Dry Reforming of Methane

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The process of dry reforming of methane (DRM) can allow the conversion of CH4 and CO2, the two main greenhouse gases (GHG), into syngas. However, the heat required for the reaction is obtained by combustion of fossil fuels, so the CO2 footprint of the process is significant. One more problematic aspect of the process concerns the heat transfer to the catalytic volume: for allowing the catalytic bed to reach and maintain the reaction temperature, the heating medium outside the tubes containing the catalyst must have a temperature higher than 1000 °C. This work proposed the process intensification of DRM by combining two innovative technologies: (i) the use of electrification for the energy supply through microwave heating and (ii) the adoption of Ni-based structured catalysts with high thermal conductivity and susceptible to microwaves. The results of the experimental tests, performed at different Weight Hourly Space Velocities (WHSV), and with the MWs on evidenced that the catalysts approached the thermodynamic equilibrium values in terms of methane conversion in all the investigated temperature and WHSV ranges, with an energy consumption of 3.5 kWh/Nm3 of produced H2 @ 700 °C.
The MW-assisted stability test performed at 10 h-1 and T = 640 °C highlighted how the developed structured catalyst was able to maintain a very stable behavior, in terms of both CH4 and CO2 conversion, which approached the thermodynamic equilibrium values for the overall duration of the test.

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