Combined steam and CO_2 reforming of methane for syngas production over carbon-resistant boron-promoted Ni/SBA-15 catalysts

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ABSTRACT

The unpromoted and B-promoted 10%Ni/SBA-15 catalysts synthesized via sequential incipient wetness impregnation approach were assessed for combined steam and CO_2 reforming of methane (CSCRM) at various reaction temperatures of 973–1073 K and stoichiometric feed composition. An expected and noteworthy drop in mean NiO crystallite size and BET surface area with boron promotion from 1% to 5%B loading could be due to the agglomeration of B_2O_3 particles and deboration reaction during calcination and hence blocking mesopores of SBA-15 support at elevated B composition. The complete NiO reduction to metallic Ni^0 form was achieved during H_2 activation and the reduction temperature of NiO phase was shifted towards higher temperature with B-addition owing to enhancing interaction between the acidic B_2O_3 and basic NiO phases. For all reaction temperature employed, 3%B appeared to be the optimal promoter loading in terms of reactant conversions and 3%B-10%Ni/SBA-15 catalyst revealed the greatest H_2 yield (69.4%) at 1073 K. In addition, CH_4 and CO_2 conversions were enhanced about 23.2% and 32.4%, correspondingly with rising reaction temperature from 973 to 1073 K.

15 was also resilient to metallic Ni^0 re-oxidation throughout CSCRM.