Hydrogen production by steam reforming of liquefied natural gas (LNG) over mesoporous nickel-based catalysts promoted with nonmetal boron

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A series of mesoporous nickel-boron-alumina xerogel (x-NBA) catalysts with different boron/nickel molar ratios (x = 0-1) were prepared by an epoxide-driven sol-gel method. The effect of boron/nickel molar ratio on the catalytic activities and physicochemical properties of nickel-boron-alumina xerogel catalysts was investigated in the steam reforming of liquefied natural gas (LNG). All the mesoporous x-NBA catalysts showed similar surface area. The introduction of boron into x-NBA catalysts reduced methane activation energy, increased nickel surface area, and increased interaction between nickel and support. LNG conversion and hydrogen yield increased with increasing the amount of adsorbed methane and with increasing nickel surface area. The amount of adsorbed methane and nickel surface area exhibited volcano-shaped trends with respect to the boron/nickel molar ratio. Among the catalysts, 0.3-NBA, which retained the largest amount of adsorbed methane and the highest nickel surface area, showed the best catalytic performance.