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CO_2 reforming of CH_4 over Ni/SBA-15: Influence of Ni loading on the metal-support interaction and catalytic activity

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Abstract

The influence of Ni loading on the properties of Ni/SBA-15 and CO_2 reforming of CH_4 were studied. XRD, BET and TGA results indicated that the increasing Ni loading (3–10 wt%) decreased the crystallinity, surface area and physically adsorbed water content of the catalysts. FTIR, TEM and H_2-TPR analysis confirmed the formation of Ni–O–Si by the substitution of surface silanol groups with Ni species and the maximum substitution of surface silanol groups with Ni were achieved at 5 wt%, while further increased in Ni loading stimulate the agglomeration of Ni particles. The activity of catalysts followed the order of 5Ni/SBA-15 > 3Ni/SBA-15 ≈ 10Ni/SBA-15 > SBA-15, with the conversion of CH_4 and CO_2 over 5Ni/SBA-15 was about 89% and 88% respectively, and CO_2/CH_4 ratio of 1.02. The superior catalytic performance of 5Ni/SBA-15 towards CO_2 reforming of CH_4 probably was related with the formation of metal-support interaction, Ni–O–Si, which enhanced the stabilization of the active Ni species on SBA-15 support and altered the properties of catalyst towards an excellent catalytic performance. The analysis of spent catalysts found that the presence of Ni–O–Si minimizes the growth of encapsulating graphite carbon and thus enhanced the stability of catalyst. This study provides new perspectives on the Ni-based catalyst, particularly on the influence of Ni on the metal-support interaction and catalytic performance of Ni/SBA-15 towards CO_2 reforming of CH_4.