Robust Ni/Dendritic fibrous SBA-15 (Ni/DFSBA-15) for methane dry reforming: Effect of Ni loadings

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ABSTRACT

A series of spherical mesoporous Ni/Dendritic Fibrous SBA-15 (Ni/DFSBA-15) catalysts with different Ni loadings (3–15 wt.%) were successfully synthesized and catalytically investigated by methane dry reforming. The XRD and Raman analyses indicated the structural stability of DFSBA-15 regardless of the Ni loading quantity, and the NiO nanocrystalline size increased with increasing Ni loading. The BET analysis showed the surface area of the catalysts decreased upon increment in Ni loading. Meanwhile, the TEM images revealed the distribution of Ni particles over the spherical shape DFSBA-15, with the most homogeneous dispersion was shown by 10Ni/DFSBA15, while Ni agglomeration was observed for 15Ni/DFSBA-15. The optimal catalytic performance and stability was achieved by 10Ni/DFSBA-15 (= 93.11%, = 91.76%, = 91.77%, Y_{CO} = 96.35%, S_{CO} = 48.89%, = 46.57% and H_2/CO = 0.95) with no sign of deactivation was observed for 30 h time-on-stream, in agreement with the XRD, XPS, and TGA analyses of spent catalysts. The superior catalytic performance by 10Ni/DFSBA-15 could be credited to its strong Si-O-Ni interaction, moderate NiO crystallite size, and homogeneous active metal dispersion. The favorable properties of 10Ni/DFSBA-15 led to a strong synergistic effect between Ni active metal sites and the DFSBA-15 support and thus enhanced the reactivity between two gaseous reactants, CH_4 and CO_2. The 10 wt.% Ni loading was certified as optimal Ni content to sufficiently suppress the coke deposition on the DFSBA-15 and thus enhance the catalytic activity and stability

KEYWORDS
Dendritic Fibrous SBA-15; Ni loadings; metal distribution; methane dry reforming

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