Synthesis Gas Production from CO2 Reforming of CH4 over Ni/MSN

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Catalytic reforming of CH4 with CO2 has recently attracted considerable attention due to simultaneous utilization and reduction of two types of greenhouse gases, CO2 and CH4 [1]. Catalysts for the CO2 reforming of CH4 had been extensively investigated. Nevertheless, the commercialization of CO2 reforming of CH4 has not been established yet due to the lack of an effective and stable catalyst. Ni-based catalysts are desirable due to their relative economic feasibility and availability [2]. However, Ni-based catalysts usually deactivated because of metal sintering and/or carbon deposition [3]. To improve its catalytic performance, the highly dispersed supported Ni-based catalysts have been investigated as they may provide efficient CH4 and CO2 conversion [4]. To date, Ni supported on mesoporous silica has been investigated for heterogeneous catalysis due to its high surface area and its ability to facilitate high metal dispersion [5].

In this work, a series of Ni incorporated mesostructured silica nanoparticles (MSN) were prepared by physical mixing method. Electrolyzed nickel oxide was used as the Ni precursor. The structural properties of Ni/MSN catalysts were characterized by X-Ray diffraction (XRD) and N2 physisorption. The catalytic properties of the catalysts were studied for the reforming of CH4 with CO2. The 10Ni/MSN catalyst showed the highest CH4 and CO2 conversion with 63.4% and 87.2 %, respectively. The results indicated that the presence a suitable amount of Ni in MSN was beneficial to achieve high catalytic activity. This behavior is closely related with both amount of active centers on the pore wall surface and the stabilized dispersion of the active sites by silica matrix. Thus, the Ni/MSN catalyst prepared by electrochemical method and physical mixing synthesis has a potential to be utilized in CO2 reforming of CH4.

Scheme 1 Proposed reaction route of CO2 reforming of CH4 over Ni/MSN


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