**Highly active Ni-promoted mesostructured silica nanoparticles for CO2 methanation**


ABSTRACT

Mesostructured silica nanoparticles (MSN) and Ni loaded onto MSN (Ni/MSN) for the methanation of CO2 were prepared by the solï gel and impregnation methods. Catalytic testing was conducted in the temperature range of 423ï 723 K under atmospheric pressure in the presence of H2. Ni supported on MSN was compared with others types of support such as MCM-41 (Mobile Crystalline Material), HY (protonated Y zeolite), SiO2 and ɔ-Al2O3. The activity of CO2 methanation followed the order: Ni/MSN > Ni/MCM-41 > Ni/HY > Ni/SiO2 > Ni/ɔ-Al2O3. The nitrogen physisorption and pyrrole adsorbed IR spectroscopy results indicated that the high activity of Ni/MSN is due to the presence of both intra- and inter-particle porosity which led to the high concentration of basic sites. In addition, the correlation between Nï H band intensity and the turnover frequency revealed that the methanation activity increased with increasing of the concentration of basic sites. The presence of defect sites or oxygen vacancies in MSN was responsible for the formation of surface carbon species, while Ni sites dissociated hydrogen to form atomic hydrogen. The surface carbon species then interacted with atomic hydrogen to form methane. The Ni/MSN catalyst performed with good stability and no deactivation up to 200 h.



**Keyword:** CO2 methanation; Ni/MSN; Basicity; Intraï inter particle pores; Oxygen vacancy