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Iron-promoted mesostructured silica nanoparticles for CO_2 hydrogenation

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The use of CO_2 as a reactant could contribute to the decreaseof greenhouse gas emissions through chemical recycling. Its use as chemical reactant (in parallel to its sequestration and storage) is limited at the moment to a few processes,although several studies on its catalytic conversion into liquid hydrocarbons have been performed. CO_2 methanation remains the most advantageous reaction with respect to thermodynamics when compared to theproduction of other hydrocarbons or alcohols.The methane productioncan be inserted into a global scheme where decarbonizedelectricity, from solar or wind power, would be used in delocalizedflexible units to perform water electrolysis to produce hydrogenwhich would react with CO_2 capture from emission sources. Hence,the methane produced can be used directly as a fuel, indirectly as anenergy source to generate electricity in a power plant or be injectedinto the existing natural gas network.[1-3]

In this study, mesostructured silica nanoparticles was synthesized by sol-gel method and was loaded with various loading of iron with 1-15 wt% of Fe. The catalysts were characterized by XRD, N_2 physisorption, DR UV/VIS,^{29}Si NMR and TEM studies. Catalytic testing was conducted in the temperature range of 573-673 K under atmospheric pressure in the presence of H_2. From the result,the introduction of Fe in MSN altered the crystallanity and Si environment of MSN. At 653 K, it was found that 10Fe/MSN exhibited the highest activity of CO_2 hydrogenation followed by 15Fe/MSN, 5Fe/MSN, 1Fe/MSN and MSN (Figure 1). The high activity of 10Fe/MSN is may be due to the balance of Fe and MSN surface sites. The Si environment in the catalysts may also affected their catalytic activity. Therefore, an appropriate amount of Fe in MSN is essential for high activity of CO_2 hydrogenation.

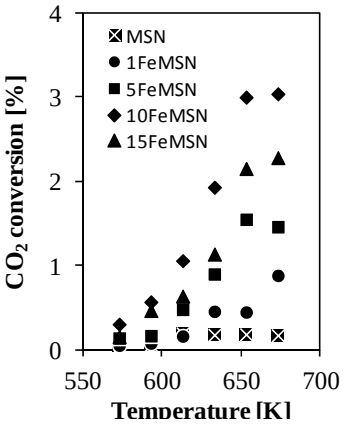

Figure 1 Catalytic testing of various Fe loading on MSN for CO_2 hydrogenation

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