CO_2 hydrogenation over Ni based catalysts

Carbon dioxide, which is primarily generated from combustion, is the most important and abundant greenhouse gas and is the main contributor to the greenhouse effect. Currently, hydrogenation of CO2 is widely used in the production of organic compounds, such as formic acid, methanol, carbon monoxide, methane, and hydrocarbons. Nickel is known to be highly active in various catalytic hydrogenation processes. The low H_2 coverage on small Ni particles leads to the quick formation of CO from the m-HCOO intermediate. As increased the Ni particle size, the selectivity switched to favor CH_4 formation, and the reaction proceeds through the mixed consecutive and parallel pathways. The ultrasmall Ni NPs (around 2.8 nm diameter) in the cage-type mesopores S16 could provide remarkably high catalytic activity for CO_2 and exhibit exceptionally high CH_4 selectivity for CO_2 hydrogenation. The Ni NPs formed in the cage-type mesopores of −COOH functionalized SBA-16 enriched the surface sites to strongly adsorb CO and CO_2, thus leading to high catalytic rates for CO_2 and CO hydrogenation. A short-channel SBA-15 with a platelet morphology is used to support Ni to effectively enhance catalytic activity and CH4 selectivity during CO_2 hydrogenation. The presence of metal–support interaction on the Ni/p-SBA-15 catalyst may increase the possibility of abundance of strongly adsorbing sites for CO and CO_2, thus resulting in high reaction rates for CO_2 and CO hydrogenation. We also used CO2 as a carbon source for conversion to carbon nanofibers through the catalytic hydrogenation reaction on a Ni-Na/Al_2O_3 catalyst. The Ag^+ adsorbed on carbon nanofibers could be spontaneously reduced through the oxidation–reduction reaction $Ni + 2Ag^+ \rightarrow 2Ag + Ni^{2+}$. The Ag deposited on the magnetic carbon nanofibers was employed to remove contaminants in water, in which 4-nitrophenol was reduced to 4-aminophenol.