Monometallic TiO₂-Ru catalyst for the selective hydrogenation of CO₂ to formic acid

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Conversion of CO₂ gas into useful feedstock/platform chemicals offers a beneficial way to lower the CO₂ level from the atmosphere as well as to synthesize chemicals using cheap source [1]. In recent years, several reactions have been studied and commercialized for the same process.

In this approach, TiO₂ was used as a support to accommodate Ru metal, as TiO₂ offers wide chemical stability and a non-stoichiometric phase. TiO₂ also counts as a good acidic support and its anatase phase provides a better surface area in order to achieve good catalytic properties [2]. We characterized our catalytic system (Ti-Ru) with sophisticated analytical techniques such as N₂ sorption method, H₂-TPR, XRD etc. The morphology of the catalysts were studied with TEM analysis (Figure 1). The particle size of catalysts lies between 6-12 (±0.5) nm and it was found in good agreement with their corresponding XRD data. We also utilized the applications of task specific ionic liquid, not only as reaction medium but also to recover formic acid [3, 4]. Such advance application of ionic liquid for Ti-Ru catalytic system offered the hydrogenation reaction in a more optimized way in order to achieve maximum selectivity (high TON/TOF value of formic acid) with the added advantages of low catalyst loading and eight times catalyst recycling (Scheme 1, Figure 2).

Scheme 1: Selective hydrogenation of CO₂ gas

Figure 1: TEM analysis of Ti-Ru catalyst

Figure 2: Ti-Ru catalyst recycling result

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