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Magneticfield–promoted cleaner production of small alcohols and hydrocarbons from CO₂ over Cu-ZnO/ZrO₂and Fe/MCM-41 catalysts

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ABSTRACT

Based on green and sustainable application for the enhancement of catalyst performance and energy conservation, an external magnetic field has been applied in CO₂ hydrogenation reaction to improve the catalytic activity and reduce the energy consumption. In this research, the performances of Cu-ZnO/ZrO₂ and xFe/MCM-41 catalysts with ferro/ferrimagnetic property under magnetic field with different magnetic flux intensities (0–27.7 mT) and orientations (north-south and south-north) were investigated. It was found that both Cu-ZnO/ZrO₂ and xFe/MCM-41 catalysts operated under magnetic field gave higher CO₂ conversions, compared to that of without magnetic field at all reaction temperatures. The highest CO₂ conversions under magnetic field condition were 1.8–3.0 times, and 1.5–1.8 times higher than that of without magnetic field for Cu-ZnO/ZrO₂ and xFe/MCM-41, respectively. These outstanding catalytic activities could be attributed to the fact that magnetic field help facilitate the reactant adsorption and surface reaction over magnetized catalysts, leading to the decrease of apparent activation energy, and the increase of selectivities to hydrocarbons and CH₃OH. Moreover, this challenge in application of magnetic field in CO₂ hydrogenation process help reduce CO₂ emission into the atmosphere compared to the convention reactor, and therefore led to the carbon-neutral CO₂ conversion process.

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