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NOVEL AND HIGHLY EFFICIENT $\text{ZnFe}_2\text{O}_4@\text{SiO}_2@\text{MIL-53}(\text{Fe})/\text{TBAB}$ CATALYTIC SYSTEM FOR SUSTAINABLE FIXATION OF CO_2 INTO CYCLIC CARBONATES

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Abstract

The conversion of CO_2 into cyclic carbonates through cycloaddition with epoxides is considered as an effective method for utilizing waste gas as a sustainable C1 resource and mitigating the greenhouse effect. In this context, a magnetic MOF catalyst $\text{ZnFe}_2\text{O}_4@\text{SiO}_2@\text{MIL-53}(\text{Fe})$ was synthesized and developed as heterogeneous catalyst for the CO_2 cycloaddition reaction. The $\text{ZnFe}_2\text{O}_4@\text{SiO}_2@\text{MIL-53}(\text{Fe})$ nanocomposite, characterized by XRD, SEM, TEM, FT-IR, UV-Vis, TG analysis and its robust magnetic core, offers a unique catalytic functionality that enhances both the reaction efficiency and selectivity. This magnetic catalyst demonstrated wide compatibility with various epoxides, requiring only trace amounts of TBAB co-catalysts to achieve excellent yields (90-98%) and selectivities ($\geq 99\%$) for the desired cyclic carbonates under mild conditions (70 °C, 1 atm). Additionally, $\text{ZnFe}_2\text{O}_4@\text{SiO}_2@\text{MIL-53}(\text{Fe})$ catalyst showed excellent recyclability, maintaining its activity even after five cycles, which indicates minimal loss (~8%) of active centers. This study offers novel insights for the development and design of green and efficient catalysts for the chemical fixation of carbon dioxide.

Key words: CO_2 conversion, cyclic carbonates, epoxides, synergistic catalytic system, sustainability

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