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"Gheorghe Asachi" Technical University of Iasi, Romania

NOVEL AND HIGHLY EFFICIENT $ZNFE_2O_4$@SIO_2@MIL-53(FE)/TBAB CATALYTIC SYSTEM FOR SUSTAINABLE FIXATION OF CO_2 INTO CYCLIC CARBONATES

Yu Lin Hu*, Pan Yan Diao, Qin Yan Shen

College of Chemistry and Chemical Engineering, Anshun University, Anshun 561000, China

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 $ZnFe_2O_4$@SiO_2@MIL-53(Fe) was synthesized and developed as heterogeneou catalyst for the CO_2 cycloaddition reaction. The $ZnFe_2O_4$@SiO_2@MIL-53(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 (≥99%) for the desired cyclic carbonates under mild conditions (70 °C, 1 atm). Additionally, $ZnFe_2O_4$@SiO_2@MIL-53(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, sustainability, synergistic catalytic system

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* Author to whom all correspondence should be addressed: e-mail: ylhanshun@126.com