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Moisture Resistant K-loaded ZIF-8 Catalyst for Glycerol Carbonate Production

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Zeolitic imidazolate frameworks (ZIFs), a subclass of metal-organic frameworks (MOFs) with structures resembling aluminosilicate zeolites, are gaining significant attention due to their unique properties. ZIF-8, in particular, has shown high surface area and enhanced hydrophobicity, making it a promising candidate for catalytic applications. In this study, ZIF-8 was synthesized in an aqueous medium by mixing 2-methylimidazole (mIm) with zinc nitrate hexahydrate (Zn) in deionized water. To improve the basicity and catalytic performance of ZIF-8, a series of K-loaded ZIF-8 catalysts (K/ZIF-8) were prepared by varying the KOH content from 5 to 10 wt%. Characterization of the synthesized catalysts was conducted using powder X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), high-resolution transmission electron microscopy (HRTEM), and temperature-programmed desorption (TPD) techniques.

The ZIF-8 and K/ZIF-8 catalysts were applied in the transesterification of glycerol (GL) and dimethyl carbonate (DMC) to form glycerol carbonate (GLC). Various reaction parameters, including DMC/GL molar ratio, KOH loading, catalyst amount, and reaction temperature, were systematically studied to optimize the GLC yield. Under optimized conditions, the 10 wt% KOH-loaded ZIF-8 catalyst (10-K/ZIF-8) demonstrated excellent catalytic activity, achieving up to 95% GLC yield at a DMC/GL molar ratio of 3:1 within 0.5 hours. Remarkably, despite the hygroscopic nature of potassium, the catalyst exhibited significant water resistance, maintaining performance with up to 5 wt% water in relation to GL. Furthermore, the catalyst retained its activity after three recycling cycles without any notable loss in catalytic efficiency. This study highlights the potential of K/ZIF-8 as an efficient, water-tolerant catalyst for the transesterification of GL with DMC, offering high GLC yields and recyclability.

Biography

Anshu Tyagi is a dedicated researcher and academic from India, specializing in the fields of biotechnology and pharmaceutical sciences. She holds a Master's degree in Biotechnology and is currently engaged in advanced research focusing on molecular markers, clinical diagnostics, and translational medicine. Ms. Tyagi has participated in various national and international conferences, presenting her research on the role of biomarkers in early disease detection and personalized therapeutics.With a strong academic foundation and hands-on laboratory experience, she has contributed to multiple interdisciplinary projects that bridge the gap between bench-side innovations and clinical applications. Her work aims to improve diagnostic accuracy and therapeutic outcomes through novel biomarker identification and validation.

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