



Zinc-tetraphenylporphyrin grafted on functionalised mesoporous SBA-15: synthesis and utilisation for nitroaldol condensation

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Abstract

Functional free-tetraphenylporphyrin (TPP) molecule was prepared by simple one-step method and subsequently zinc ion was introduced in the cavities of TPP (Zn-TPP). The prepared functional free Zn-TPP was grafted by covalent bonding of zinc with amine functionality present on the internal surface of organo-functionalised mesoporous SBA-15 molecular sieves through axial position. The resultant material was completely characterised using various analytical and spectroscopic techniques including Fourier-transform infrared spectroscopy (FT-IR), ultraviolet–visible spectroscopy, proton nuclear magnetic resonance, X-ray powder diffraction, thermo-gravimetry–differential thermal analysis, ¹³C magic-angle spinning nuclear magnetic resonance (MAS-NMR), N₂ physisorption studies, scanning electron microscopy (SEM) and transmission electron microscopy (TEM) techniques. The presence of organo-functionality and Zn-TPP on the surface was confirmed by conducting ¹³C MAS-NMR and FT-IR studies. Often, zinc containing functional porphyrin derivatives have shown as potential biological, luminescent properties, whereas in the present studies the functional free Zn-TPP and heterogenised functional-free Zn-TPP materials (SBA-15-AM-Zn-TPP) explored for the first time as catalytic materials for nitroaldol condensation under varying reaction conditions. The present functional free Zn-TPP has an advantage of ease on preparation and strong interaction on the surface linker through axial position, which made it a potential catalyst for aldol condensation and exhibit promising catalytic activity.

Keywords Zinc · Macromolecule · Nitroaldol condensation · Mesoporous SBA-15 · Functionalized material

1 Introduction

Catalysis plays a crucial role in the production of fossil fuel, commodities, fine chemicals, pharmaceuticals, and other products in an environmental- friendly manner. More than 80% of the industrial chemical processes are based on catalysis. For these methods, homogeneous catalysts such as transition metal-based organometallic complexes play a crucial

role due to their high activity under mild reaction conditions [1]. However, homogeneous catalysts exhibit limited applications such as low selectivity, and low atom efficiency due to the difficulties that occur during catalyst—product separation, recovery, and recyclability. Therefore, the heterogenization of the homogeneous catalysts has become a valuable research area in the chemical synthesis. The immobilization of the homogeneous catalytic system is an attractive alternative to heterogeneous catalysts and provides a single site catalyst in chemical synthesis, which is a novel and environmental friendly process. Several attempts were made to immobilize homogeneous organometallic complexes to support materials by using chemisorption, immobilization, trapping inside the cavities of zeolites, etc [2].

The development of new methods for the preparation of organometallic complexes and their stabilization on the heterogeneous supports are important goals for both academic and industrial research. Organometallic complexes exhibit many fine chemical transformations, drug molecular syntheses, and petrochemical processes in an atom-efficient

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