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Nanosize Magnetic Metal-Organic Framework UiO-66 as a Catalyst Support to immobilize Palladium: An Efficient catalyst for Cyanation of Aryl Halides

M. Heidarian Haris[1], A. Jarahiyan[1], A. Pourjavadi[1], F. Matloubi Moghaddam[1]*
[1] Laboratory of Organic Synthesis and Natural Products, Department of Chemistry, Sharif University of Technology, Tehran, Iran
[2]Polymer Research Laboratory, Department of Chemistry, Sharif University of Technology Tehran, Iran
⋮
* matloubi@sharif.edu

Abstract

In this study, a magnetic zirconium-metal organic framework (Zr-MOF, UiO-66-NH_2) was solvothermally synthesized. At first, Fe_3O_4@SiO_2 nanoparticles were modified with acrylic acid and then UiO-66-NH_2 was grown on them. In order to immobilize of palladium, the Zr-MOF was functionalized by 2, 4, 6-trichloro-1, 3, 5-triazine and 5-phenyl tetrazole. The properties of the Fe_3O_4@modified UiO-66@Pd were investigated by various techniques such as FT-IR, FESEM and EDX. The FESEM images showed particles size was around 135 nm. After that, the catalyst tested for a coupling reaction: cyanation of aryl halides and desired products were synthesized in excellent yields. It is worth to note, mild reaction condition and shorter reaction time are the advantages of using this prepared catalyst.

Keywords: Nano-UiO-66; Palladium catalyzed; Coupling reaction; MOF nanocomposite

1. INTRODUCTION (with two 9 pt lines space from the keywords)

The structure and chemical properties of catalyst surface can influence on activity and selectivity of catalysis. In recent years, nanocatalysts have been attracted attention due to their high surface area and consequently high catalytic activity [1]. Among different types of catalysts, heterogeneous catalysts play a crucial role in many organic reactions owing to their recyclability, insolubility in solvents and long-term stability [2, 3]. In a heterogeneous catalyst, having an appropriate solid support is vital to immobilize various metals. For this purpose, a wide range of materials is used to fabricate different types of such catalysts [4, 5].

During the previous years, metal-organic frameworks (MOFs) have recently sparked new scientific interest with multifunctional applications due to their controllable porous structure, higher specific surface areas and large diversity in the structure and binding groups of the organic linker [6, 7]. Because of high content of transition metals, and possibility to be designed and modified after synthesis, they are suitable candidate as heterogeneous catalysts [8]. These properties encouraged us to prepare a magnetic zirconium-metal organic framework (magnetic Zr-MOF) via solvothermal method as a solid support and palladium was immobilized into it after modification. After characterization, it was used to develop C-C coupling reaction condition: cynation of aryl halides.

2. MATERIALS AND METHOD

All chemicals were supplied from Merck Chemical Co and Sigma Aldrich which used without any additional purification. FE-SEM (TESCAN–Mira III at 15 KV) was applied to investigate microstructure of the samples. FT–IR spectra were recorded by an ABB Bomem MB100 spectrometer with KBr pellets.