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Immobilization and characterization of Pd catalyst on ionic liquid based periodic mesoporous organosilica: As an efficient and reusable catalyst for Sonogashira coupling reaction

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ABSTRACT

In this paper, an ordered mesoporous organosilica with ionic liquid framework supported palladium (Pd@PMO-IL) was synthesized and characterized by using Fourier transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM) techniques. The catalytic application of the Pd@PMO-IL was investigated in Sonogashira coupling reaction that products with good yields were obtained. The recoverability and reusability of the catalyst were also investigated under applied conditions.

Keywords: Mesoporous Organosilica, palladium, ionic liquid, Sonogashira coupling reaction

1. INTRODUCTION

In the past few decades, periodic mesoporous organosilicas (PMOs) have initiated a huge revolution in various scientific communities such as chemistry, physics, medicine, *etc*. These materials are used in a variety of fields, such as drug delivery, protein delivery, synthesis of heterogeneous catalysts, sensors, artificial photosynthetic systems and photovoltaic materials due to features such as non-toxicity, high hydrophobicity, high surface area/pore volume ratios, high chemical and thermal stability, adjustable pore dimensions, high loading and uniform distribution of organic functional groups in the framework, confinement effect and synergistic effect [1-6]. In particular, these materials have been received significant interest in the field of catalysis. As the evolution of the synthesis of PMO in recent years has shown, PMO materials have been prepared by using different sources of organosilica and successfully applied as supports for the immobilization of organic and inorganic catalysts in chemical processes [7,8]. In the meantime, in recent years ionic-liquid-based PMO (PMO-IL) material have been very much considered in our research team and its function was investigated in the immobilization and stabilization of various catalysts. Our observation suggests that PMO-IL is an effective support for stabilization and immobilization of various catalysts and also plays an important role in the recoverability, reusability and stability of the catalyst. Some heterogeneous catalysts with PMO-IL support developed in our research team in recent years are Mn@PMO-IL, BPMO–IL–SO_3H, Cu@PMO-IL, BPMO-IL-KCO_3, ILNOS-Ti, Ni@IL-OMO and Pd@ILEt-BNOS [9-15].

On the other hand, in recent years, palladium-catalyzed organic reactions have attracted a lot of attention due to the good catalytic properties of palladium. The Suzuki, Heck and Sonogashira coupling reactions are examples of palladium-catalyzed reactions. The Sonogashira coupling reaction is a powerful method for the synthesis of unsymmetrical and symmetrical bisarylethynylenes. This reaction is used in the synthesis of polymers, foldamers, dendrimers and dendritic acetylene compounds that are useful in optical and electronic applications. Hence, in recent years, the important goal is the development of novel catalysts and new reaction conditions for Sonogashira coupling [16-19].

In this regard, according to importance of ionic-liquid-based PMO (PMO-IL) and also Sonogashira reaction, the Pd@PMO-IL was prepared, characterized and applied as powerful and efficient catalyst in the Sonogashira coupling reaction. The recoverability and reusability of the catalyst were also investigated in this reaction.