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Preparation and characterization of MCM-41 supported molybdenum oxide nano-catalyst and its performance in catalytic oxidative desulfurization of dibenzothiophene

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ABSTRACT

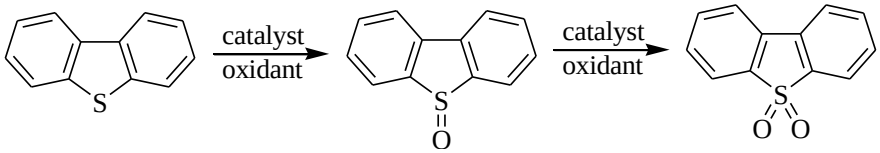
In this paper, molybdenum oxide supported on mesoporous silica (MCM-41) has been successfully synthesized by impregnation method. The obtained nano-catalyst was characterized using X-ray diffraction, Fourier transform infrared spectra and Field Emission Scanning Electron Microscopy coupled with energy dispersive X-ray technique, and finally applied to catalytic oxidative desulfurization of dibenzothiophene (DBT) of model oil. The results indicated that molybdenum oxide species as the ODS active sites were highly dispersed on meporous silica surface. The influence of main operating parameters of reaction including the catalyst dosage, oxidant/sulfur molar ratio, reaction time and reaction temperature on the conversion of DBT, as well as reusability of the nano-catalyst were investigated. Under mild reaction conditions, the prepared catalyst exhibited excellent performance in oxidative desulfurization of DBT. On the basis results, the reaction mechanism of catalytic oxidation of DBT in presence this catalyst was proposed.

Keywords: Oxidative desulfurization, Mesouporous silica, Dibenzothiophene, Catalyst

1. INTRODUCTION

The sulfur compounds in the fuel are a major source of pollution; their combustion poisons catalytic converter and products sulfur dioxide which is chief source of acid rain. Therefore, the removal of sulfur from fuels is essential from an environmental point of view [1]. In order to effectively control air pollution, most countries of the word released environmental regulation on the specifications of sulfur level in hydrocarbon fuels to less than 10 ppm [2].

The conventional hydrodesulfurization (HDS) technology in the refinery is highly efficient at removing sulfur compounds but this method needs severe conditions such as high temperature and hydrogen pressure for removal refectory organosulfure such as dibenzothiophene and its derivatives [3]. Therefore, several new processes as alternatives to HDS have been developed. Among them catalytic oxidative desulfurization appears is a promising approach. Because it has high advantages over HDS such as the mild operating conditions [4]. By this method, at the presence of oxidant and a suitable catalyst organosulfur compounds selectively oxidized to their corresponding sulfoxides and sulfunes (Scheme 1), which can be easily remove from oil by solvent extraction, adsorption or distillation [5].



Scheme 1. Example of the catalytic oxidative desulfurization reaction.