Temperature-Programmed Reduction of Copper-Manganese Catalysts Derived from Biomass Activated Carbon

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Abstract

This study investigates the potential of bimetal impregnated catalysts supported on activated carbon derived from biomass for Selective Catalytic Reduction (SCR) of Nitrogen Oxides (NO_x) with ammonia (NH_3). The bimetal catalysts, Copper-Manganese (Cu-Mn) was deposited onto palm kernel shell (PKS) and coconut shell (CS) via impregnation method and calcined at 250 °C. Hydrogen Temperature-programmed reduction analysis (H_2-TPR) using 5% Hydrogen gas (H_2) in Argon (Ar) have been carried out to study the effect of different variables such as metal impregnation and support properties on the reduced states of the catalysts. Besides, FTIR, TGA and XRD were also used to characterize the catalysts. It was observed that impregnation of bimetals enhanced the catalyst characteristics where include important results from FTIR, TGA, XRD and H_2-TPR. Based on the results presented in H_2-TPR analysis, it was observed that the reduction peak of bimetal catalysts deposited on palm kernel shell activated carbon shifted to high temperature, about 597 °C. This demonstrates the intensity of the precursor interaction exists and a higher dispersion of bimetals on the surface of the support. In addition, the higher dispersion of bimetals was shown in XRD analysis. Hence, palm kernel shell-derived catalysts could be new and promising catalysts in SCR system.

Keywords: Activated carbon, Catalyst, SCR, H_2- TPR, XRD

1. Introduction

Nitrogen oxides (NO_x) are one of the greenhouse gases with an atmospheric lifespan of 1 to 7 days for nitric oxide and 170 years for nitrogen dioxide [1]. The origins of NO_x are categorized into mobile and stationary sources where, mobile source refers to combustion of fossil fuels from automobile system; meanwhile stationary source is referring to emission of flue gas due to combustion of coke from electrical power plants. Emission of NO_x to the atmosphere has been linked to a variety of environmental problems including rain acidification, global warming, photochemical smog, formation of ground level ozone and greenhouse effects, as well as health related issues such as

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