Vietnam Journal of Catalysis and Adsorption
Tạp chí xúc tác và hấp phụ Việt Nam

http://chemeng.hust.edu.vn/jca/

Carbon supported nano-sized Au catalysts for toluene removal in humid condition

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ARTICLE INFO

Received: 25/10/2018

Accepted: 28/12/2018

Keywords: nano Au; carbon support; toluene removal; low temperature oxidation; humid condition

ABSTRACT

In this study,one-step impregnation methodwas successfully used in preparation of gold nanoparticles supporting on granular carbon. By this method, in the presence of $Fe_2O_3$the size of Au particles was 10÷15 nm which was smaller than that in the absence of Fe_2O_3. Thecatalysts were characterized to evaluate crystalline structure, surface properties and morphology.These materials are then used for catalytic oxidation of toluene under various conditions such as temperature, moisture content and gas hourly space velocity (GHSV).Results showed that the catalyst exhibited catalytic oxidationactivity even at low temperatures (at 75°C). Inverse effects of moisture were observed between low temperature reaction (75°C) and high temperature reaction (200°C).

Introduction

Volatile organic compounds (VOCs) are one of the major causes of air pollution. In fact, Increased VOCs emissions not only directly threaten people through their toxicity, can cause cancer,but also indirectly result in photochemical smog and ozone pollution[1].Therefore, the development of effective methods and materials for the abatement of VOCs is of great significance. Catalytic oxidation is considered to be the most promising method for VOCs destruction. Unlike adsorption, in which VOCs are just transferred from gas phase to the adsorbent and the adsorbent needs frequent regeneration, catalytic oxidation can destruct VOCs and convert them into harmless CO_2 and water [2-3].

However, some problems remain to be solved with VOCs catalytic oxidation.Reaction temperatures are generally much higher than 200°C [4-6].It hasthe risk of explosion and the formation of NO_x byproduct for heating the entire gasstream to a high temperature [3, 7]. Furthermore, The deactivation of the catalyst may be due to the presence of water in almost all of the emissions and formation in the oxidation reaction. However, the effect of moisture on oxidation of VOCs was studied by only a few research groups. Huang et al. reported that the catalytic deactivation of benzene using nanoparticles MnO_2 carrying on the zeolite was due to the occupation of the active part and the adsorption centers by steam [8].Recently, Soares et al. reported in 2016 that the negative effects of steam on the oxidative reactions of ethyl acetate and butyl acetate on the cryptomelane catalyst (MnO_2) have been observed [9].However, Wu et al. reported that for Pt/activated carbon catalysts, moisture content was reduced significantly due to hydrophobic properties of activated carbon [10].