CHEMISTRY & CHEMICAL TECHNOLOGY

Chem. Chem. Technol., 2020, Vol. 14, No. 1, pp. 32–37 **Chemistry**

CATALYTIC PERFORMANCE OF COPPER-MANGANESE SUPPORTED ON ACTIVATED CARBON SYNTHESIZED BY DEPOSITION-PRECIPITATION METHOD

Melody Kimi[1, ✉], Bibie Nur Syafiqah Safiuddin[2], Suh Cem Pang[2]

https://doi.org/10.23939/chcht14.01.032

Abstract. $CuMn_x$/activated carbon (AC, x = 0.1, 0.2, 0.5 and 1) nanoparticles were prepared by deposition-precipitation method. The catalytic performance of $CuMn_x$/AC catalysts were studied for the oxidation of benzyl alcohol to benzaldehyde. The molar ratio of Mn plays an important role in the catalytic performances. The optimum amount of Mn is 0.1 with the highest benzyl alcohol conversion of 63 %.

Keywords: benzyl alcohol oxidation, bimetallic catalyst, activated carbon, copper, manganese.

1. Introduction

Selective catalytic oxidation of alcohols to produce the corresponding aldehydes and ketones, in particular, benzyl alcohol to benzaldehyde has been regarded as one of the most important organic transformations in industrial chemistry [1, 2]. Benzaldehyde has been widely applied in the manufacture of odorants, flavours and pharmaceutical intermediates as an important raw material [3]. It is generally prepared in the industry either by hydrolysis of benzyl chloride or by oxidation of toluene [4]. Environmental concern has forced researchers to explore benign synthetic methods. Therefore, many new processes for benzaldehyde synthesis have emerged and catalytic oxidation of benzyl alcohol to benzaldehyde has attracted much attention both in laboratory and chemical industry. The usage of heterogeneous catalyst for the liquid-phase selective oxidation of benzyl alcohol under mild conditions has attracted attention from the viewpoint of sustainable chemical processes [5, 6].

Solid catalysts used for the catalytic oxidation of benzyl alcohol to benzaldehyde include metals [7, 8], metal oxides [9] and supported metals or metal oxides [10, 11]. The use of transition metals such as Cu [12, 13] and Mn [9, 14, 15] containing catalysts offer a good alternative in comparison to the expensive noble metals. Choudhary *et al*. [12] have tested the performance of Cu containing hydrotalcite-like solid catalysts with 41 % conversion for the oxidation of benzyl alcohol [12]. Encapsulated Cu(II) complexes in zeolite-Y also showed a conversion of 29 % for similar reaction [16]. Manganese oxide is extensively studied because of its strong oxygen storage/release ability, excellent redox properties and low cost [17, 18]. Manganese oxide was reported as a superior catalyst for the aerobic oxidation of benzyl alcohol in liquid-phase with up to 100 % selectivity [19]. The catalytic activity of Mn species was very much dependent on the oxidation state [20].

Supported metal catalyst has been proven to improve the selective conversion of benzyl alcohol to benzaldehyde by oxidation reaction. The use of activated carbon (AC) as a catalyst support to immobilised metal catalyst offers advantages such as high surface area and corrosion resistance [21]. Both the texture and surface chemistry of AC support have distinct effect on the catalytic performance of AC supported catalysts [22, 23]. The ability of AC to activate molecular oxygen that is essential for oxidation reaction was also reported [24].

A comparative catalytic study was carried out to evaluate the catalytic performance of $CuMn_x$/AC for the selective oxidation of benzyl alcohol. The catalytic performance in the liquid-phase oxidation of benzyl alcohol with hydrogen peroxide as the oxidant was examined and the influence of Mn mol ratio has been thoroughly investigated. The $CuMn_{0.1}$/AC showed the best catalytic performance, which suggests that the amount of Mn play a crucial role. Typically, a high conversion of 63 % as well as product selectivity of > 99 % was achieved within very short reaction time (2 h) under mild conditions. The characterization results showed the particle size and metal dispersion are dependent on the Mn loading which are then interrelated with the catalytic performances.

[1] Centre for Pre-University Studies, University Malaysia Sarawak, Kota Samarahan, Malaysia
[2] Department of Chemistry, Faculty of Resource Science and Technology,
University Malaysia Sarawak, Kota Samarahan, Malaysia
✉ *kmelody@unimas.my*