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Effect of carbon support on the catalytic performance of Cu-based nanoparticles for oxidative carbonylation of methanol

Guoqiang Zhang, Junfen Yan, Jiajun Wang, Dongsen Jia, Huayan Zheng, Zhong Li*

Key Laboratory of Coal Science and Technology of Ministry of Education and Shanxi Province, Institute of Coal chemical Engineering, Taiyuan University of Technology, Taiyuan 030024, Shanxi, China

*Corresponding author. Mailing address for correspondence: No. 79 Yingze West street, Taiyuan 030024, China. Tel/Fax: +86 351 6018526

E-mail address: lizhong@tyut.edu.cn (Z. Li)

Abstract

Cu-based nanoparticles supported on three different carbon materials including: activated carbon (AC), ordered mesoporous carbon (OMC), and multiwalled carbon nanotubes (CNT) were prepared by ultrasonic assisted incipient-wetness impregnation and evaluated in oxidative carbonylation of methanol under atmosphere pressure. Samples were characterized by BET, XRD, TEM, H₂-TPR and XPS. The pore structure of carbon supports had significantly affected the location and dispersion of Cu species and the increased surface oxygenated groups promote Cu²⁺ reduced to (Cu⁺ + Cu⁰). The Cu/OMC catalyst showed superior initial activity than Cu/AC and Cu/CNT catalysts because of smaller particle size of Cu species and moderate amounts of active species. The Cu/CNT catalyst was more stable than Cu/AC and Cu/OMC during the reaction process, and its deactivation is due to the oxidation of the active Cu₂O and Cu. Unlike Cu/CNT, the deactivation of Cu/OMC and Cu/AC was caused by the oxidation of the active Cu species (Cu₂O + Cu⁰) and the increased particle size of Cu species.

Keywords: Cu-based catalysts, carbon support, oxidative carbonylation, SOG, pore structure, confinement effect, deactivation

1. Introduction

With the rapid growing production of methanol, the green transformation of

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