11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Selective Self-Condensation of Acetone Over Nano Zinc Oxide/Ruthenium/Activated Charcoal Catalyst

A. A. Bagabas[(1)*], V. M. Akhmedov[(2)], M. M. Mostafa[(3)] and A. F. AL-Ghashem[(1)]

(1) Petrochemicals and Refining Center, Petroleum and Petrochemicals Research Institute, King Abdulaziz City for Science and Technology, P. O. Box 6086, Riyadh 11442, Kingdom of Saudi Arabia, e-mail: abagabas@hotmail.com
(2) Department of Chemistry, Baku Branch of Moscow State University, F. Agayev St. 14, Baku, Azerbaijan Republic, e-mail: akhmed26@yahoo.com
(3) Department of Chemistry, Faculty of Science, King Abdulaziz University, P. O. Box 80203, Jeddah 21589, Kingdom of Saudi Arabia, e-mail: mmokhtar2000@yahoo.com
* Corresponding author.

Abstract – Nano zinc oxide (*n*-ZnO), mixed in different weight ratios, with ruthinium-supported on activated charcoal (Ru/AC) formed effectively multifunctional, selective catalysts for the one-step vapor phase acetone self-condensation, under H_2 atmosphere, to methyl isobutyl ketone (MIBK). Diisobutyl ketone (DIBK) and isopropyl alcohol (IPA) were the major byproducts. The acetone conversion and selectivities towards MIBK, DIBK, and IPA depended on reaction temperature, hydrogen and acetone flow rates, and the mixing weight ratio of Ru/AC to *n*-ZnO. All the catalysts exhibited stable activity over a period of 4 hours, irrespective of reaction conditions.

The aim of this work is to study the vapor phase conversion of acetone into MIBK under atmospheric pressure of H_2 over mixture of *n*-ZnO and Ru/AC, with emphasis on the effect of reaction conditions (temperature, H_2 flow rate, acetone flow rate, and catalyst identity) on acetone conversion and selectivities of products.

n-ZnO was prepared according to the literature procedure [1]. This oxide was then mechanically stirred with the commercially available Ru 5% on AC catalyst at the desired ratios. The vapor phase of acetone self-condensation was performed under atmospheric pressure, in the temperature range of 473-673 K, in a glass fixed-bed microreactor in a flow of H_2 (5-15 ml/min), and at a continuous acetone flow rate range of 0.01-0.02 ml/min. The reaction liquid products were trapped at 253 K, were collected every one hour, and were analyzed by off-line gas chromatography (GC).

Acetone conversion and product selectivity were strongly affected by reaction conditions. The results obtained revealed that increasing temperature from 523 K to 643 K led to a small increase in acetone conversion, with a dramatic increase in MIBK selectivity, a slight increase in DIBK selectivity and a significant decrease in IPA selectivity (Fig. 1a). The increase in H_2 flow rate (Fig. 1b) caused a significant increase in acetone conversion and in MIBK and DIBK selectivity. Acetone flow rate (Fig. 1c), in comparison to that of H_2, had much less effect on the selectivity of MIBK and of DIBK. However, it strongly influenced the acetone conversion and slightly affected the IPA selectivity. The increase in Ru/AC:*n*-ZnO weight ratio (Fig. 1d), resulted in a significant increase in the acetone conversion with slight increase in the MIBK selectivity. The DIBK selectivity and MIBK + DIBK total selectivity had maxima at catalyst weight ratio of 1:1. The IPA, in contrast, reduced upon increasing the catalyst weight ratio from 0.5 to 1.0 and then stabilized when increasing the ratio from 1.0 to 1.5.

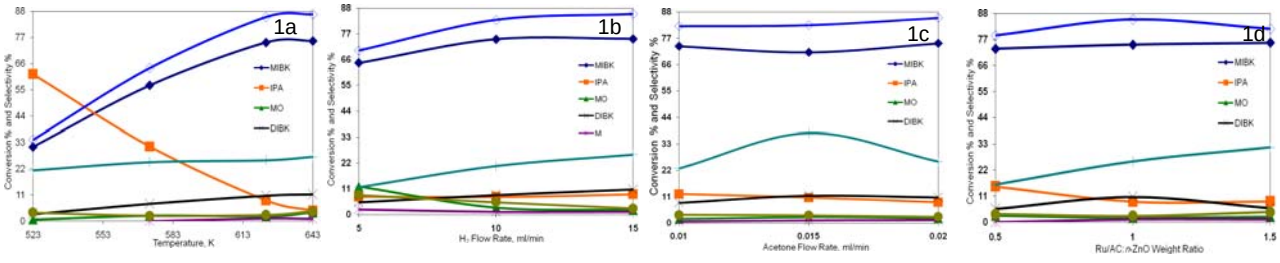

Figure 1: Acetone conversion and product selectivities (1:1 Ru/AC:*n*-ZnO weight ratio, 15 ml/min H_2 flow, 0.02 ml/min acetone flow, and 1 hour time on stream).

References

[1] A. Bagabas, A. Aplett, A. Shemsi, Z. Seddigi, Main Group Chem. 7, 1 (2008) 65-81.