Nitrogen doped graphene-supported trimetallic CuNiRu nanoparticles catalyst for catalytic dehydrogenation of cyclohexanol to cyclohexanone

ABSTRACT

In different hydrocarbons reactions, copper based catalysts have industrial importance especially in the synthesis of the cyclohexanone from dehydrogenation of the cyclohexanol. At operating conditions, one of the significant problems in the industrial process is fast deactivation of the copper based catalysts. The present work focuses on the formulation of two types of the supported catalysts namely supported tri metals alloy (CuNiRu/N-rGO) in paper forms and supported copper (Cu/N-rGO), analysing the properties of the synthesised catalyst support (N-rGO) by Brunauer-Emmett-Teller (BET), X-ray photoelectron spectroscopy (XPS), Temperature-programmed desorption (TPD-NH3), Temperature Programmed Reduction (TPR-H2) and X-ray diffraction (XRD) as well as to investigate the catalytic performance of the two supported catalysts in the dehydrogenation of cyclohexanol to the cyclohexanone. All experiments on the catalytic performance were conducted at moderate temperatures (200–270 °C), 1 atm, 0.1 ml/min cyclohexanol flow rate and ~8 h time on stream (TOS). The performances of the catalysts were evaluated in the gas phase dehydrogenation of cyclohexanol to the cyclohexanone. The conversion of the cyclohexanol using CuNiRu/N-rGO is 4% higher compare to use of the Cu/N-rGO. The selectivity for cyclohexanone in case of the Cu/N-rGO catalyst is about 83.88%, whilst, the CuNiRu/N-rGO illustrated approximately 6% better performance. The yield of the cyclohexanone using the Cu/N-rGO is about 78%, while by adding the Ni and Ru as promoters with the improvement of the Cu/N-rGO the yield of cyclohexanone was improved by 8%. The duration of the steady state period significantly improved by using CuNiRu/N-rGO which was proposed up to 7 times. This research shows that the CuNiRu/N-rGO catalyst provides the suitable and selective active sites for the dehydrogenation of cyclohexanol to the cyclohexanone reaction.

Keyword: Cyclohexanol dehydrogenation; Copper catalyst; Tri metallic catalyst; Cu and Cu+ active sites