Rhodium Nanoparticles Incorporated Mesoporous Silica as an Active Catalyst for Cyclohexene Hydrogenation under Ambient Conditions

Nabil Al-Zaqri

Abstract:

Rhodium (Rh) nanoparticles were embedded in the mesopores of TUD-1 siliceous material and denoted as Rh-TUD-1. Five samples of Rh-TUD-1 were prepared with different loadings of Rh that ranged from 0.1 to 2 wt% using the sol-gel technique. The prepared samples were characterized by means of several chemical and physical techniques. The obtained characterization results show the formation of highly distributed Rh0 nanoparticles with an average size ranging from 3 to 5 nm throughout the three-dimensional silica matrix of TUD-1. The catalytic activity of the prepared catalysts was evaluated in the solvent-free hydrogenation of cyclohexene to cyclohexane at room temperature using 1atm of hydrogen gas. The obtained catalytic results confirm the high activity of Rh-TUD-1, in which aturn over frequency(TOF)rangingfrom4.94to0.54s−1 was obtained. Moreover, the change in reaction temperature during the reaction was monitored, and it showed an obvious increase in the reaction temperature as an indication of the spontaneous and exothermic nature of the reactions. Other optimization parameters, such as the substrate/catalyst ratio, and performing the reaction under non-ambient conditions (temperature = 60◦C and hydrogen pressure = 5 atm) were also investigated. Rh-TUD-1 exhibited a high stability in a consecutive reaction of five runs under either ambient or non-ambient conditions.