

# Dehydrogenation of butenes over copper oxide supported on alumina under anaerobic conditions : Bifunctionality of the catalyst

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1,3-butadiene is a primary skeletal building block for synthetic rubber and has been used widely in the manufacturing of a large number of chemical products [1,2]. Over 95 percent of butadiene is produced as a byproduct of ethylene production from steam cracking. However, the demand for 1,3-butadiene is increasing rapidly and on-purpose routes (i.e., dehydrogenation technology) that can boost the production of 1,3-butadiene are strongly required in the petrochemical industry. There have been two approaches of direct dehydrogenation and oxidative dehydrogenation to produce 1,3-butadiene from butenes [3-7], but they should be advanced technically due to the following problems.

The direct dehydrogenation of butane is a fairly simple and attractive route to produce 1,3-butadiene. However, controlling undesirable side reactions such as butane cracking and coke formation over the catalyst surface can complicate the formation process [8-13]. The endothermic characteristic requiring additional heat during the reaction is another disadvantage, and the maximum yield for 1,3-butadiene is limited when a thermodynamic equilibrium point is reached.

In order to circumvent the problems of direct dehydrogenation, exothermic oxidative dehydrogenation has been suggested. However, it is difficult to conduct the oxidative dehydrogenation of butane to 1,3-butadiene selectively without a loss of the hydrocarbon feed due to the complete oxidation to CO<sub>2</sub>, especially in a

concentration feed composition without dilution. This remains a quite challenging issue when attempting to use oxidative dehydrogenation to produce 1,3-butadiene selectively without the formation of carbon oxides.

In this work, to induce a more selective dehydrogenation process, the dehydrogenation of butenes was carried out under anaerobic conditions over a supported oxide catalyst having bifunctionality (redox-coupling of active metal oxide and isomerization of its supporting material). In order to monitor the initial catalytic performance, the yield of 1,3-butadiene and carbon oxide according to the depletion of lattice oxygen was examined using a gas chromatograph equipped with a trapping multi-position valve.

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