

Synchronized dehydrogenation-hydrogenation reactions over partially reduced MoO₂ based catalyst for simultaneous synthesis of styrene and aniline

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Abstract

The dehydrogenation of ethylbenzene (EB) to styrene and hydrogenation of nitrobenzene (NB) to aniline are important industrial reactions due to the widespread applications of styrene and aniline. The individual dehydrogenation of EB and hydrogenation of NB have several limitations such as the former is reversible and thermodynamically limited, while the latter consumes hydrogen to produce aniline. A continuous system that combines dehydrogenation with a release of hydrogen to be utilised in hydrogenation circumvents the requirement for an external H₂ supply. Recently, much attention has been focused on the concepts of coupling two contradictory reactions over a single catalyst. The study has gained a momentum and various reactions involving coupling of hydrogenation and dehydrogenation have been reported. Such process has several advantages like operational simplicity, mitigation of thermodynamic limitations, eco-friendly operations, and enhanced product selectivity. The limitations existing in the individual reactions can be thus eliminated by coupling it with another. Dehydrogenation of EB and hydrogenation of NB can also form an interesting pair of reactions to be carried out over a single catalyst.

In this work, The coupling of ethylbenzene dehydrogenation with hydrogenation of nitrobenzene to produce styrene and aniline over a single MoO_x supported on TiO₂-Al₂O₃ catalyst

was performed. The study determines the feasibility of in situ H₂ generation from dehydrogenation reaction and its direct utilisation in hydrogenation reaction. Consequently, this eliminates the additional supply of H₂ for hydrogenation of nitrobenzene. Alternatively, the heat liberated from the hydrogenation reaction can be utilized by endothermic dehydrogenation reaction. The active MoO₂ species could effectively catalyse both the reactions to yield styrene and aniline simultaneously.

Biography

Itika Kainthla is a researcher in heterogeneous catalysis. She recently completed her two-years Post doctoral research with Prof. Eric Gaigneaux, UCLouvain, Belgium, Europe. She received her Ph.D. degree from CNMS, Jain University, Bangalore on the topic "Transition Metal based Nano Catalysts for Hydrogenation, Dehydrogenation and Coupling Reactions." under the guidance of Dr. B.M. Nagaraja. She has a good academic record with a Gold medal in Masters' in Nanotechnology from Mt. Carmel College, Bangalore University. She has published about 10 articles in peer reviewed journals and bags several best presentation awards in National/International conferences.