Anaam Al-Shaikh Ali et al., J Pet Environ Biotechnol 2016, 7:4(Suppl)
http://dx.doi.org/10.4172/2157-7463.C1.019

Hydrogen carrier using organic metal hydride: Non-noble metal Ni-based catalysts for dehydrogenation of methylcyclohexane

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A liquid organic hydride couple, methylcyclohexane (MCH) – toluene (TOL), has been industrially considered as potential and effective route for efficient hydrogen storage and transport. The beauty of this process is that the hydrogen is chemically bound to a liquid carrier with high gravimetric and volumetric energy density at ambient pressure and temperature. Moreover, the system upholds a closed carbon cycle which significantly diminishes the chemical and thermal pollution formed by greenhouse gas emission. It is, however, essential to have very selective catalysts for both hydrogenation and dehydrogenation to close the mass balance. It has been reported that the Pt based catalyst is the only selective catalyst for the dehydrogenation of MCH to TOL which is disadvantage due to its high cost. Thus, it is required to develop non-noble metal catalysts that can substitute Pt, making the process cost-effective and wide availability. Ni is a well-known dehydrogenation catalyst, but the major drawback of Ni based catalyst in this dehydrogenation reaction is its hydrogenolysis activity leading to inferior selectivity. The aim of this research is to find an alternative non-noble multi-component catalysts that can show excellent catalytic performance, particularly achieving high selectivity comparable to that of Pt based catalysts. Ubiquitous bi-metallic nanoparticles catalysts have been synthesized using homogeneous deposition precipitation method. Among the catalysts investigated, the Ni-Zn based catalysts have shown outstanding high selectivity of TOL (>99% at low conversion), with an only trace amount of benzene and methane as the major by-products comparing to the corresponding Ni based catalyst. The main role of Zn over Ni based catalyst in promoting the selectivity towards dehydrogenation of MCH to TOL will be discussed.

Biography

Anaam Al-Shaikh Ali is currently a PhD candidate at King Abdullah University of Science and Technology (KAUST) from 2013-present. She received the Master's Degree at Manchester University, UK in 2011. She has been working as a lab scientist for Saudi Aramco, Research and Development Center, Saudi Arabia from 2006 to present. She obtained the Bachelor Degree in Chemistry from King Faisal University in Damman, Saudi Arabia. Her main research interests are heterogeneous catalysis and metal nanoparticles for industrial application.

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