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Two-dimensional inorganic electride promoted electron transfer efficiency in transfer hydrogen reactions of carbon-carbon multiple bonds

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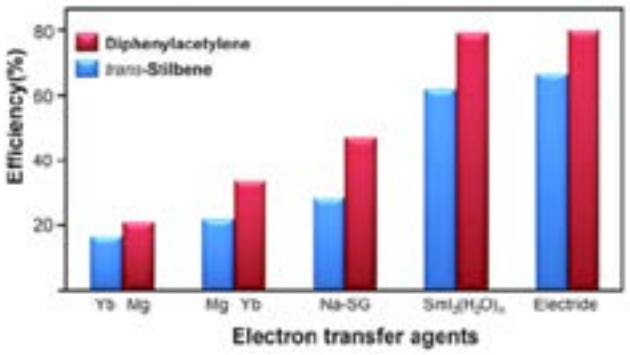
The development of simple and efficient chemical transformation routes with maximal yields has been a continuously pursued challenge in synthetic chemistry. Such protocols can provide important benefits in the field of organic synthesis such as saving starting materials, reagents, and energy, thereby lowering production costs and environmental impacts. Among fundamental reactions in synthetic organic chemistry, the reduction of organic functional groups with carbon–carbon (C–C) multiple bonds is one of the most universally applied and crucial synthetic processes in academic and industrial circles. For efficient electron transfer hydrogenation, it is essential to use an agent with a high reduction potential to facilitate the electron transfer. In this regard, many types of materials, such as simple metals (Mg and Yb), stabilized alkali metal systems (Na in silica-gel and in ammonia liquid), and lanthanide iodides (SmI_2 and TmI_2), have been employed in electron transfer hydrogenation. Despite their effectiveness in the reported transfer hydrogenations, there are several drawbacks in the methodology. Major disadvantages include the toxicity, the cost of agents and the rigorous reaction conditions. Furthermore, the separation of products from the resultants is laborious and inefficient, yielding pollutants. Of all these drawbacks, the low electron transfer efficiency of the reaction is the most critical issue to be addressed for efficient transfer hydrogenation. In this presentation, we will introduce simple and highly efficient transfer hydrogenation of alkynes and alkenes by using a two-dimensional electride, dicalcium nitride ($[Ca_2N]^+ \bullet e^-$), as an electron transfer agent. Excellent yields in the transformation are attributed to the remarkable electron transfer efficiency in the electride-mediated reactions. We found that the choice of solvent was crucial for enhancing the electron transfer efficiency, and a maximum efficiency of 80% was achieved by using a DMF mixed isopropanol co-solvent system. This is the highest value reported to date among single electron transfer agents in the reduction of C–C multiple bonds.



Biography

Ye Ji Kim got her Bachelor's degree in Chemistry from Kyungsung University in 2013. Since 2013, she joined prof. Sung Wng Kim's group of Sungkyunkwan University as Post-Graduate student. Her research interest includes chemical application of inorganic electride, single electron transfer reaction, hydrogen evolution reaction and nano-particle fabrication.

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