A fullerene-based catalyst for molecular hydrogen activation with comparable catalytic hydrogenation capability to noble metal catalyst

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Molecular hydrogen is not only a bright future fuel, but also is widely used today in fundamental chemical transformations. For example, all crude oil is treated with H_2 and 10^8 tons of ammonia fertilizer is produced annually via catalytic hydrogenation. Any small improvement of the performance and cost of the catalysts would help to cut the cost of these important processes. But such improvements are hard to achieve because the H_2 is held together in a strong marriage. It can be split apart by using a transition metal as the catalysts. Here we demonstrate that fullerene can activate the molecular hydrogen and act as the novel hydrogenation catalyst The hydrogenation of aromatic nitro compounds to amino aromatics is achieved with high yield and selectivity. At C_{60}:C_{60}^-=2:1, ~100% conversion and ~100% selectivity of the hydrogenation reactions are achieved under 120-160°C and 4-5MPa H_2 pressure.

In addition, they exclusively catalyze the reduction of the nitro group without metal salts and avoid the accumulation of the corresponding hydroxylamine and the formation of azoxy and azo compounds. These findings foreshadow a new catalytic system available for fundamental research as well as the industry applications. Moreover, the catalysts developed here could replace expensive precious metal catalysts; therefore, they offer the potential benefit of lowering the cost and diminishing environmental problems from heavy-metal pollutants.

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