Hydrogenation of Alkenes Using Copper Nanoparticles Supported on Diamond

Significance: Copper nanoparticles supported on diamond nanoparticles (Cu/DH) catalyzed the hydrogenation of alkenes with \( \text{N}_2\text{H}_4\cdot\text{H}_2\text{O} \) to give the corresponding alkanes in 60–100% conversion with selectivities of the desired products from 96 to >99% (19 examples, eq. 1). The catalyst was recovered by centrifugation and reused three times without significant loss of the catalytic activity in the hydrogenation of styrene (3th reuse: 94% conversion, >99% selectivity).

Comment: The authors previously reported the preparation of Cu/DH and their application to the aerobic oxidation of thiols (ChemCatChem 2013, 5, 241). The catalytic activity of Cu/DH was superior to that of copper nanoparticles supported on activated carbon, graphite, and multi-walled carbon nanotubes and gold and palladium nanoparticles supported on DH. Phenyl acetylene underwent the hydrogenation under similar conditions to give styrene and ethylbenzene (39% conversion; styrene/ethylbenzene = 61:39).

\[
R^1\begin{array}{c} \text{Cu/DH (0.16 mol% Cu)} \\
\text{aq NH}_3 \text{(0.025 mL)} \\
\text{EtOH (4 mL), 60 °C} \\
\text{3–33 h} \\
\end{array}
+ R^2\begin{array}{c} \text{N}_2\text{H}_4\cdot\text{H}_2\text{O} \\
(1 \text{ mmol}) \\
0.1 \text{ mL} \\
\end{array}
\rightarrow R^1\begin{array}{c} \text{H} \\
\text{H} \\
\text{R}^3 \end{array}
\]

Selected examples:

- 100% conversion >99% selectivity
- 60% conversion 99% selectivity
- 99% conversion 98% selectivity
- 89% conversion 99% selectivity
- 99% conversion 99% selectivity
- 95% conversion 99% selectivity
- 96% conversion 99% selectivity
- 95% conversion 99% selectivity
- 99% conversion 99% selectivity
- 99% conversion 99% selectivity
- 39% conversion styrene/ethylbenzene = 61:39 (from phenyl acetylene)