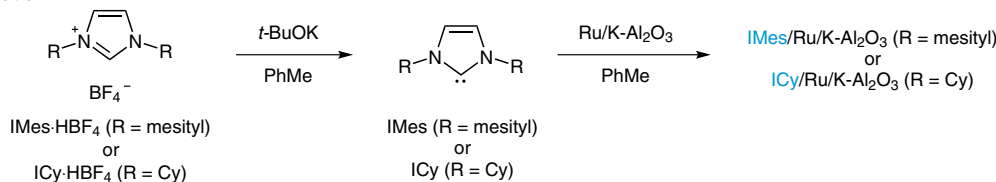


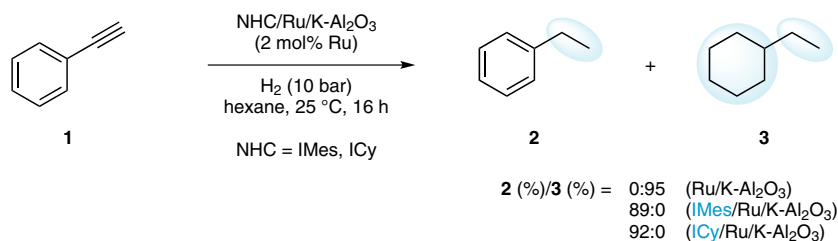
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Tunable Heterogeneous Catalysis: N-Heterocyclic Carbenes as Ligands for Supported Heterogeneous Ru/K-Al<sub>2</sub>O<sub>3</sub> Catalysts to Tune Reactivity and Selectivity  
*J. Am. Chem. Soc.* **2016**, *138*, 10718–10721.

# Hydrogenation on NHC-Modified Ru/K-Al<sub>2</sub>O<sub>3</sub> Catalysts

## Preparation:



## Selected examples:



**Significance:** A surface-modification method was developed for tuning the catalytic performance of ruthenium nanoparticles supported on K-doped alumina (Ru/K-Al<sub>2</sub>O<sub>3</sub>) by using N-heterocyclic carbene (NHC) ligands. For example, the hydrogenation of ethynylbenzene (**1**) under hydrogen in the presence of unmodified Ru/K-Al<sub>2</sub>O<sub>3</sub> gave ethylcyclohexane (**3**) as the sole product in 95% yield, whereas the use of IMes/Ru/K-Al<sub>2</sub>O<sub>3</sub> or ICy/Ru/K-Al<sub>2</sub>O<sub>3</sub> (2 mol% ruthenium, NHC-modified Ru/K-Al<sub>2</sub>O<sub>3</sub>, 3.0 equiv of the NHC based on surface ruthenium) as a catalyst under similar conditions gave ethylbenzene (**2**) as the sole product in 89% and 92% yield, respectively.

**Comment:** The catalysts were characterized by means of <sup>13</sup>C solid-state NMR, Ru 3p XPS, Ru K-edge EXAFS, and TEM. The particle size of ruthenium (TEM), the oxidation state of ruthenium (XPS), and the Ru–Ru coordination number (EXAFS) remained unchanged after the surface modification. In addition, <sup>13</sup>C NMR spectroscopy confirmed that the carbene carbon was directly attached to the ruthenium nanoparticles.

Category

Polymer-Supported  
Synthesis

Key words

N-heterocyclic  
carbenes

ruthenium catalysis

hydrogenation

heterogeneous  
catalysis

ligands

Synfact  
of the month