## Synthesis of Amines from Alcohols and Urea with $\mathrm{Ru}(\mathrm{OH})_{\mathrm{x}} / \mathrm{TiO}_{2}$



Significance: $\mathrm{TiO}_{2}$-supported ruthenium hydroxide $\left(\mathrm{Ru}(\mathrm{OH})_{x} / \mathrm{TiO}_{2}\right)$ catalyzed the reaction of alcohols $\mathbf{1}$ with urea in mesitylene under Ar atmosphere to give the corresponding tertiary amines $\mathbf{2}$ or secondary amines $\mathbf{3}$ in 76-98\% yield (13 examples). The catalyst was recovered by simple filtration and reused without significant loss of catalytic performance for formation of $\mathbf{3 k}$ (reuse: 90\% yield). No leaching of ruthenium was observed by ICP-AES analysis after the reaction.

Comment: The authors have previously reported the preparation of $\mathrm{Ru}(\mathrm{OH})_{x} / \mathrm{TiO}_{2}$ and its application to the hydrogen transfer reactions (Chem. Eur. J. 2008, 14, 11480). The catalytic activity of $\mathrm{Ru}(\mathrm{OH})_{x} / \mathrm{TiO}_{2}$ was superior to that of the other supported ruthenium catalysts for the formation of $\mathbf{2 a}\left[\mathrm{Ru}(\mathrm{OH})_{x} / \mathrm{Al}_{2} \mathrm{O}_{3}: 47 \%\right.$ yield, $\mathrm{RuCl}_{x} / \mathrm{TiO}_{2}$ : 0\% yield, RuHAP: 0\% yield, Ru/C: 18\% yield].

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