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Reduction of Carboxamides to Imines Catalyzed by the Schwartz Reagent

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PURPOSE OF THE ABSTRACT

Carboxamides are prevalent in pharmaceuticals, agrochemicals and natural products as well as a variety of functional materials. Therefore, methods to reduce these bonds could open new opportunities for late-stage functionalization and post-polymerization modification to access new chemicals that are difficult to synthesize by classical methods.[1] However, the carboxamide C=O bond is relatively inert to hydride addition, which means that forcing conditions are often required, leading to issues with functional group tolerance and chemoselectivity. Several catalytic protocols have been developed to enable the use of milder reducing agents; however, most of these protocols form amines as the final product and typically proceed by initial formation of the imine equivalent followed by further reduction.[2] The development of methodologies that avoid overreduction to the amine product and instead allow selective formation of the corresponding imine are rare but highly valuable and can complement traditional methods for imine synthesis.[3]

Ganem and co-workers showed that the commercially available and well-defined Schwartz reagent ($\text{Cp}_2\text{Zr(H)Cl}$) can reduce carboxamides to imines stoichiometrically with liberation of $(\text{ClZrCp}_2)_2\text{O}$. [4] Inspired by this work, we report the use of silanes as stoichiometric reductants to unlock a catalytic protocol for this transformation, using $\text{Cp}_2\text{Zr(H)Cl}$ as a catalyst for the deoxygenation of a range of secondary carboxamides. This catalytic system retains the excellent chemoselectivity observed for the original stoichiometric protocol. We have investigated the mechanism of this reaction through the isolation of potential reactive intermediates as well as developing one-pot processes for the further derivitization of the imine products. This work presents a rare example of Zr hydride catalysis, enabling the practical and efficient functionalization of a challenging class of substrates without recourse to highly sensitive reagents or rare and expensive metals.

FIGURES

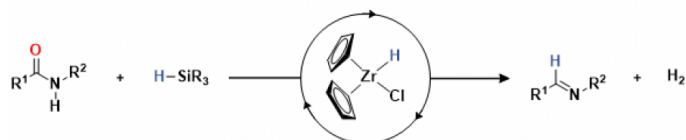


FIGURE 1

Scheme 1.

The Zr-catalysed reduction of carboxamides to imines.

FIGURE 2

KEYWORDS

Homogeneous Catalysis | Amide | Hydrosilylation | Zirconium

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