About the Dehydrogenation of Diformamides to Diisocyanates – A Greener Pathway for the Production of Polyurethanes

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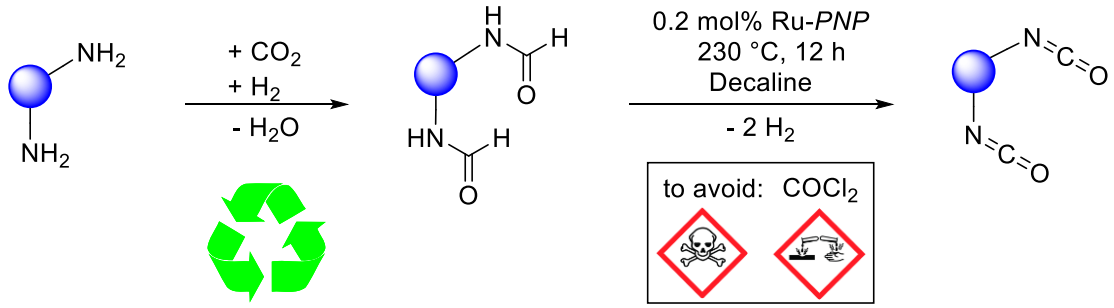
Abstract

The synthesis of isocyanates, which are essential building blocks for the production of polyurethanes, has traditionally relied on the use of hazardous and environmentally unfriendly reagents such as phosgene.[1] However, recent advancements in catalysis and sustainable chemistry have opened up new pathways for the production of isocyanates through more eco-friendly means. In 2021, approximately 1,300,000 tons of polyurethane were produced in Germany alone, underlining the immense demand for these materials.[2]
To date, there no research has been published on the dehydrogenation of formamides to isocyanates via homogeneous transition metal catalysis. Herein, we address this gap by employing homogeneous ruthenium-pincer catalyst systems to facilitate the direct conversion of formamides into isocyanates.[3] This ground-breaking approach not only eliminates the use of toxic phosgene but also offers a sustainable alternative to conventional diisocyanate synthesis.[4] By utilizing fermentation processes, amines can be accessed from biomass sources, providing an eco-friendly source for the production.[5] Furthermore, an incorporation of an oxidative carbonylation method for the formamide formation using CO_2-derived methyl formate as a feedstock, aligning with the principles of carbon neutrality and a potential circular economy.[6] This research contributes to a new field in the synthesis of isocyanates by formamide dehydrogenation, offering a cleaner and safer approach. Within this work, we manage to synthesize isocyanates with a yield up to 48% and a selectivity up to 99%.



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