Production of Amines from Alcohol and Ammonia

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Overview

A novel, selective, and direct synthesis of primary amines from alcohols and ammonia catalyzed by novel Pincer-type Ruthenium complexes.

Amines are widely used in the production of industrially relevant products. Standard commercial methods for synthesis of amines also make use of alcohols and ammonia as reagents, yet require harsh conditions, and result in a mixture of the final products and by-products.

these challenges in amine production along with issues of cost, environment, and energy consumption there is an urgent need for improved methods in the production of amines. The group of Prof. David Milstein at the Weizmann Institute of Science (WIS) have developed a Ruthenium catalyst that facilitates the selective synthesis of primary amines using the customary starting materials (alcohols and ammonia) yet only requiring mild reaction conditions and high selectivity.

The Need

Present production methods of amines require harsh conditions such as high reaction temperatures (over 300oC) and pressures (over 15 atm). These reactions result in a mixture of final products including both primary and secondary amines, as well as alkanes and alkenes byproducts. These byproducts necessitate costly work-up and waste treatment.

The Solution

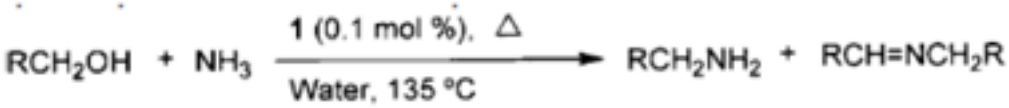
Pincer-type Ruthenium complexes answer the problems of current synthetic methods, as the complexes provide a means to significantly decrease production costs. By enabling single-step and selective synthesis of primary amines from alcohols and ammonia in an environmentally friendly and economically superior manner. This was demonstrated under mild conditions using water as a solvent, and even eliminating the use of a solvent.

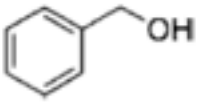
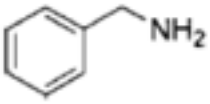
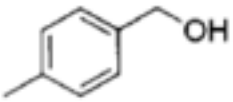
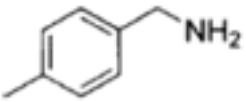
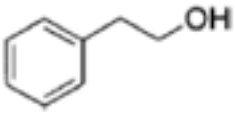
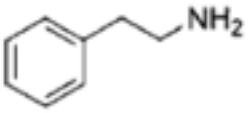
Advantages

- Mild reaction conditions (Low temperatures ~130 Â°C and atmospheric pressure)
- Single step synthesis
- High product yields
- Water or no solvent required
- No toxic reagents or byproducts

Development Status

Proof of Concept: Potential demonstrated for both aromatic and aliphatic amines:



Entry	RCH_2OH	t [h]	Conv.	RCH_2NH_2	Yield [%][b]
1		18	100		95.4 (86)
2		18	100		91.7
3		36	100		80.4[c]
4		24	92.4		54.8[d]
5[e]		28	89.4		74.3
6[f]		30	99		79.7
7[f]		30	98.7		70.0

Patent Status

USA Granted: 8,889,865 USA Granted: 8,779,136 USA Granted: 8,586,742