"N-Heterocyclic carbene/Brønsted acid cooperative catalysis as a powerful tool in organic synthesis"

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Abstract

The interplay between metals and N-heterocyclic carbenes (NHCs) has provided a window of opportunities for the development of novel catalytic strategies within the past few years. The recent successful combination of Brønsted acids with NHCs has added a new dimension to the field of cooperative catalysis, enabling the stereoselective synthesis of functionalized pyrrolidin-2-ones as valuable scaffolds in heterocyclic chemistry. This Commentary will briefly highlight the concept of N-heterocyclic carbene/Brønsted acid cooperative catalysis as a new and powerful methodology in organic chemistry.
Scheme 1: Synthesis of the first free and stable N-heterocyclic carbene by Arduengo [2].

Scheme 2: Conjugate "umpolung" of α,β-unsaturated aldehydes.

Scheme 3: The carbene + conjugate acid – azolium + base equilibrium.
Scheme 4: Formation of Breslow intermediates 10 and iminium salts 12 and their use toward the synthesis of y-lactams 13.

Scheme 5: Synthesis of trans-y-lactams 16 through NHC/Brensted acid cooperative catalysis.
Figure 1: Proposed hydrogen-bonding intermediates 19 in the formation of pyrrolidin-2-ones 16.