Catalytic enantioselective reduction of nitroalkenes in DESs

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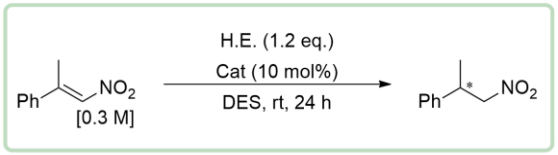
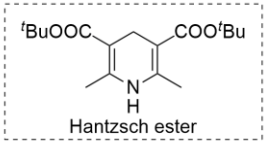
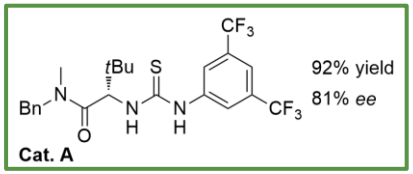
1 Catalyst screening

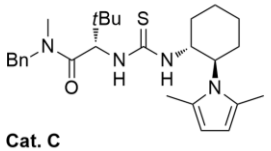




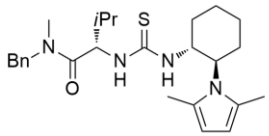
DES: ChCl/glycerol (1:2)



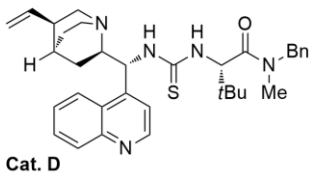
Cat. A — 92% yield, 81% *ee*



Cat. C — 88% yield, 70% *ee*



Cat. B — 52% yield, 56% *ee*



Cat. D — 63% yield, < 5% *ee*

2 DES screening

Entry	Reaction medium	Yield (%)	*ee* (%) (Cat A)
1	ChCl/glycerol (1:2)	92	81
2	ChCl/urea (1:2)	77	65
3	ChCl/L-lactic acid (1:3)	25	34
4	L-menthol/L-lactic acid (1:2)	62	< 5
5	L-proline/L-lactic acid (1:4)	76	54
6	Betaine/glycerol (1:2)	76	72
7	Betaine/glycolic acid (1:2)	70	78
8 (60 °C)	D-proline/L-malic acid (1:2)	59	78
9 (60 °C)	L-proline/L-malic acid (1:2)	65	75
10	Glycerol	68	86
11	Water	60	80
12	Methanol	50	35

[1] E. L. Smith, A. P. Abbott, K. S. Ryder, *Chem. Rev.* **2014**, *114*, 11060.

[2] N. J. A. Martin, L. Ozores, B. List, *J. Am. Chem. Soc.* **2007**, *129*, 8976.

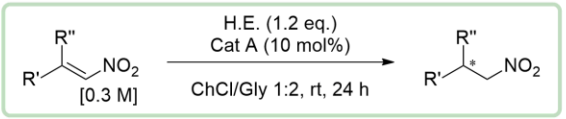
One of the major culprits of waste production in chemical industries is the use of solvents, therefore the study of **alternative and environmentally benign solvents** is a topic that is gaining a steadily increasing attention.

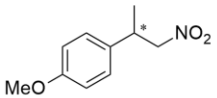
Deep Eutectic Solvents (DESs)[1] are mixture of two or three components, typically derived from natural sources, which are capable of forming hydrogen bond interactions with each other, thus producing an eutectic mixture with a melting point lower than either of the individual components.

We report our efforts for the development of the **first organocatalytic reduction** involving hydrogen bonding interactions among the substrate, the reagent and the catalyst in deep eutectic solvents which are made in turn of hydrogen bonds.

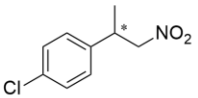
We optimized the reduction of β,β-disubstituted nitroalkenes with Hantzsch ester in the presence of thiourea-based chiral bifunctional catalysts to promote the formation of enantioenriched β-branched nitroalkanes, that was published by List[2] and co-workers, employing DESs as reaction medium instead of traditional organic solvents.

3 Scope

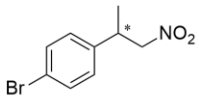




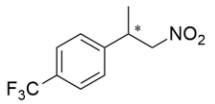
70% yield
80% *ee*



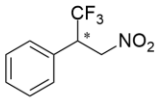
83% yield
82% *ee*



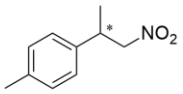
80% yield
78% *ee*



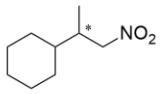
84% yield
76% *ee*



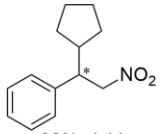
70% yield
77% *ee*



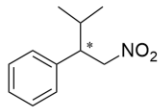
72% yield
77% *ee*



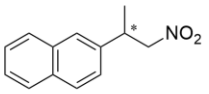
87% yield
60% *ee*



92% yield
87% *ee*



57% yield
89% *ee*



82% yield (80 °C)
70% *ee*

Unpublished results