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Application of cinchona-squaramide organocatalyst immobilized on polybenzimidazole membrane and its recovery by nanofiltration

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Due to the numerous advantages over conventional transition metal catalysis, organocatalytic methodologies have become an attractive synthetic tool in asymmetric catalysis. However, the cumbersome product purification by column chromatography, and the need for catalyst recovery and reuse call for the design of more flexible and sustainable organocatalytic strategies. Immobilization of organocatalysts on polymer supports was proposed to overcome the separation bottleneck; however, binding a homogeneous catalyst to solid surfaces often led to a deterioration in catalytic activity and enantioselectivity. Consequently, the scientific and technological challenges of realising highly efficient asymmetric reactions and simultaneously developing practical separation strategies are yet to be solved.

Given the achieved yield and enantiomeric excess, we demonstrate an efficient and eminently suitable membrane based strategy for asymmetric organocatalysis. A cinchona squaramide and a polybenzimidazole membrane were successfully modified with azide and propargyl functionalities, respectively. Finally, the catalyst was clicked onto the nanofiltration membrane.

The asymmetric organocatalysis with integrated separation was successfully demonstrated in a two stage membrane cascade reactor. The separation allowed >98% product recovery and 99% unreacted substrate recovery. The *in situ* solvent recovery mitigated the need for solvent addition for purification purposes. The concept of catalyst grafted membrane cascade reactor presented herein enables new possibilities for fine chemical manufacturing, and further boosts growth in the exciting new era of organocatalysis.

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