Polymer-Immobilized Co-Salen Catalysts for the Hydrolytic Kinetic Resolution of Racemic Epoxides

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The dynamic kinetic resolution of enantiomers is rapidly becoming an important method for the production of chiral building blocks for fine chemicals and pharmaceuticals. In this method, a racemic compound is resolved to an enantiomerically pure form by selectively converting one enantiomer of the racemic mixture (with a maximum 50% yield and 100% ee). A significant limitation of this method, however, is that the catalysts employed are often homogeneous metal complexes composed of expensive transition metals and chiral ligands. Furthermore, an added problem is that the catalysts routinely have a very short activity window before the catalytic properties (activity, enantioselectivity) begin to degrade.

Immobilized chiral metal complex catalysts can circumvent many of the limitations associated with the homogeneous analogues. Catalyst recovery can be enhanced and total turnover numbers can be increased by isolating the complexes on a solid support, preventing deactivation via bimolecular pathways. However, design of effective catalysts is not as trivial as simply adding the homogeneous complex to a support, as uncontrolled complex-support interactions can alter the ligand sphere around the metal, leading to changes in catalytic activity and enantioselectivity.

Of the ligands used in homogenous, chiral catalysis, only a few are widely applicable to many different chiral chemistries – these have been deemed “privileged catalysts or ligands” In particular, Jacobsen’s salen ligand is an ideal ligand for immobilization because it can be used to ligate a variety of different metals, leading to myriad different chiral chemistries. Here we describe our efforts in the design of new, polymer-supported Co-Salen complexes for the hydrolytic kinetic resolution (HKR) of racemic epoxides.

Epoxide ring-opening reactions promoted by the Me-Salen system have been reported to utilize mechanisms that are both monometallic and bimetallic. In some cases, it has been reported that the proper dimeric catalyst design can lead to homogeneous complexes that have both high activity and high enantioselectivity compared to the simple, monomeric species that was first discovered by Jacobsen. With this in mind, we developed several new methodologies for immobilization of chiral Co-Salen complexes on polymeric supports. Well-defined, chiral salen ligands were immobilized on styrene and norbornene-based monomers using a rigid linker that promotes the accessibility of the complex by moving it away from the polymer backbone. The monomers could be polymerized in a controlled manner, leading to well-defined supported catalysts. These catalysts were evaluated in the HKR of rac-epichlorohydrin and were found to be active, selective and recyclable (near quantitative conversions and >99% ee)[1]. The impact of changing catalyst structure (ligand, support tether, support structure) on the catalytic properties was enumerated.

1. Zheng, Jones and Weck, *Chem. Eur. J.* **2005**, in press.