

Asymmetric Peptide Catalysis – From Simple to Complex Systems

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In nature, proteins fulfill manifold different functions and are crucial as, for example, enzymes or templates for the controlled formation of structural components such as bones. The Wennemers group is intrigued by the question of whether also peptides with significantly lower molecular weights than proteins can fulfill functions for which nature evolved large macromolecules. Specifically, we ask whether peptides can serve as effective asymmetric catalysts, synthetic collagen-based materials, or for imaging and targeting of fibrotic tissue.

The lecture will focus on stereoselective peptide catalysts of the general type H-Pro-Pro-Xaa. These peptides allow for catalysis *via* an enamine intermediate with loadings of as little as 0.05 mol% and provide synthetically versatile products from aldol and conjugate addition reactions with high stereoselectivities. The lecture will discuss the scope of the peptide-catalyzed reactions and insights into the mechanism. We will show which structural and functional features distinguish the peptides from other chiral amine catalysts and highlight how changes in the conformational properties enable tuning of the catalytic activity, stereoselectivity, and chemoselectivity.

The lecture will include machine learning approaches and photochemical transformations. Finally, peptide catalysis in complex environments (*e.g.*, cell lysates) and cascade reactions with enzymes will be presented.