

At the Water/Oil Interface-Chiral Catalysis

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Commentary

For many years, synthetic chemists have been fascinated by the unusual physicochemical features of water as a solvent, and remarkable research progress on chemical reactions under aqueous circumstances has been recorded. Catalytic asymmetric reactions have also been demonstrated, with water serving as a novel solvent as well as a participant in the reactions. We outline and analyse recent achievements in chiral catalysis at the water/oil interface in this Perspective. The principles and procedures employed in chiral organocatalysis and metal catalysis are highlighted.

The discovery of effective catalytic methods for the synthesis of enantioenriched products is highly desirable, driven by the ever-increasing need for optically pure compounds in the pharmaceuticals sector, materials science, and agriculture. Because of its practical advantages, such as the recovery and reuse of the costly chiral catalyst/ligand and the decrease of contamination by catalyst residues in the products, heterogeneous chiral catalysis has sparked a lot of attention. In most cases, immobilised solid chiral catalysts are used in the liquid phase for heterogeneous chiral catalysis. Liquid/liquid biphasic chiral catalysis, a new type of heterogeneous chiral catalysis, was recently discovered. Some nonconventional reaction media, such as aqueous phase, fluoruous phase, ionic liquid, and supercritical carbon dioxide, are used as "mobile carriers" to immobilise chiral catalysts *via* noncovalent bonding interactions. Water/oil biphasic catalysis has gotten a lot of attention among the many liquid/liquid biphasic systems because water as a reaction medium has cheap cost, safety, and environmental friendliness. In water, however, good catalytic performance is frequently more difficult to attain. Hydrophilic modification of chiral catalysts *via* sulfonation or quaternary cation salt production, the use of amphiphilic additives such as surfactants or phase-transfer catalysts, and so on have all been used to achieve asymmetric catalysis using water as the solvent. Water has been recognised as a crucial promoter in some organic processes catalysed by enzymes for the creation of diverse compounds with precise chiral centres in nature. In this context, in the 1980s, Breslow published ground-breaking research on the acceleration of achiral Diels-Alder processes in water. Sharpless then defined various "on water" reactions, which demonstrate a considerable rate acceleration when compared to the identical reaction in an organic solvent. Following that, a huge number of chemical reactions in aqueous media were reported. Theoretical models primarily aim to explain how water accelerates the rates of chemical reactions "on water" or "in water," as mentioned in prior outstanding reviews and articles. Among them, hydrogen-bonding interactions at the interface and hydrophobic effects were primarily blamed for such rate acceleration in the water/oil biphasic system. As a result, in the subject of chiral catalysis, water as a reaction medium has become a hot topic. A variety of C-C and C-heteroatom bond forming reactions have been reported, and considerable effort has gone into developing water-compatible catalytic asymmetric reactions. The recent achievements in chiral catalysis at the water/oil interface through asymmetric organocatalysis and metal catalysis are briefly summarised in this Perspective.