L-Proline and D-Proline (Chiral Amino Acid Catalysts)

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In the 21st century, the use of small organic molecules as chiral organocatalysts has become a powerful strategy and an attractive field in organic chemistry. Among the catalysts developed, L/D-proline and its derivatives catalyzed a wide range of reactions. L/D-Proline collectively has the application as catalysts in asymmetric Mannich reactions for chiral β-aminocarbonyls, alddehyde aldol reaction for the synthesis of erythrose equivalents, domino Mannich–Aza-Michael reactions, Morita–Bayliss–Hillman reactions, Heck cross-coupling reactions, multicomponent reactions, in the synthesis of bioactive diketopiperazines, spirooxindazoles and in phosphodiester bond linkages to recognize DNA and RNAs and in bifunctional catalysts, it acts as co-catalyst. In addition, the application in the preparation of a wide variety of chiral catalysts like chiral MOFs, Barbas–List aldol catalysts, bile acid catalysts and has excellent use in autocatalysis strategy, to form the initial enantiorich isomers, which further autocatalyze the reactions. L/D-proline also served as building blocks in construction of chiral 3D architectures.

Table 1 Use of L-Proline and D-Proline (Chiral Amino Acid Catalysts)

(A) In a recent one-pot chiral synthesis, the Shi group used L/D-proline as Lewis base, in the presence of a chiral auxiliary group to synthesize substituted isoxazoline-N-oxides highly chemo- and enantio-selectively in good yields. With either L- or D-proline, the absolute stereochemistry of isoxazolidines was identical.

(B) If an additive is used, L/D-proline catalyze the cross-aldol reaction of ethyl benzoyl(diethoxymethyl)phosphinate and acetone for the synthesis of α-hydroxy-H-phosphinate synthons in an organocatalyzed reaction. These are used in the synthesis of a variety of organic phosphorus compounds.
In an enantioselective asymmetric hetero-Diels–Alder reaction of enones and aldehydes, the Zhao group used supramolecular bifunctional organocatalysts, which were synthesized by using L/D-proline and Cinchona alkaloids (quinidine thiourea), linked to each other through ionic hydrogen bonds for high stereoselectivity.

References