

Chiral Chemistry

A full portfolio of asymmetric chemistry
with decades of expertise in chiral resolution



- 1 Asymmetric synthesis
- 2 Catalytic and biocatalytic transformations
- 3 Chiral separations

With over **40 years** of expertise in **biotechnology** and **decades** of experience in **asymmetric synthesis** and **chiral resolution**, we have established the production of **more than 100 chiral compounds**, including both natural and non-natural amino acids.

COMPREHENSIVE TECHNOLOGY PORTFOLIO

- Full range of services from chiral pool synthesis to chemo- and biocatalysis.
- Strong capabilities in carbohydrate chemistry and purification.
- Broad technology offerings for nucleoside APIs.

ASYMMETRIC SYNTHESIS & CATALYSIS

Development, optimization, scale-up, and production of chiral compounds using:

- Heterogeneous catalysis (e.g., hydrogenations)
- Heterogeneous catalysis via chiral complexes
- Reductive amination
- Hydrazone reduction

BIOCATALYTIC APPROACHES

- Commercial fermentation and biocatalysis production across five global sites.
- Diverse enzymatic toolbox with > 20 enzymes.
- Applications include:
 - L- and D-amino acids (hydantoinases)
 - R- and S-alcohols (alcohol dehydrogenases)
 - D- and L-serine (aldolases)
 - L-tert-leucine (amino acid dehydrogenase)
 - Chiral terminal epoxides

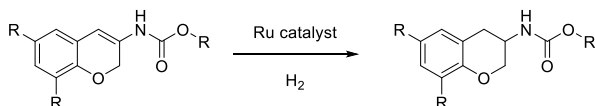
CHIRAL RESOLUTION TECHNIQUES

Experienced in various commercial-scale approaches for:

- Production of chiral alcohols
- Production of chiral amines through lipase-catalyzed chiral resolution

Example #1: Homogeneous Catalysis

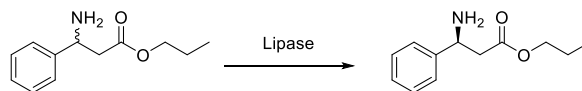
HOMOGENEOUS CATALYTIC HYDROGENATION



- Optimized ligand and metal precursor, catalyst loading and reaction conditions
- > 99 % conversion with > 95 %ee
- > 99 % ee achieved after product isolation through crystallization

Example #2: Enzymatic Chiral Resolution

PRODUCTION OF L-BETA-AMINO ACIDS



- Inexpensive and readily available starting materials and broad substrate scope
- > 90 % isolated yield, > 99 %ee
- Commercial production

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