



Johnson Matthey Catalysts

Catalysis & Chiral Technologies

CHIRAL TECHNOLOGIES

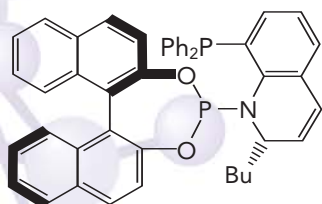
Johnson Matthey is an invaluable resource for the development of reliable and efficient technologies for asymmetric catalysis. Our solutions portfolio provides access to a large and structurally varied collection of ligands and catalyst systems including:

- Noyori's ruthenium systems for asymmetric ketone reduction
- PhanePhos, ParaPhos, P-Phos, QuinaPhos, BINAM-P, MeBoPhoz™, covering the majority of known applications in C=C, C=O and C=N hydrogenation catalysis

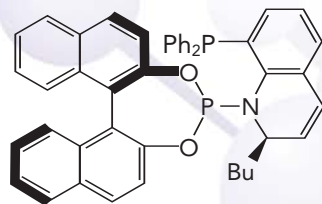
Together with the backing of an elite scientific advisory board, our staff of accomplished scientists continue to be a driving force in developing, optimizing and commercializing new technologies.

QuinaPhos

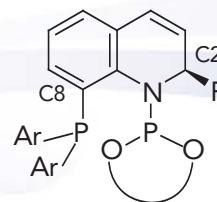
QuinaPhos is a novel bidentate phosphine-phosphoroamidate ligand that has been developed by the group of Prof. Leitner^[1]. The versatility of the phosphine-phosphoroamidate motif makes it applicable in a number of catalytic transformations, including rhodium-catalyzed asymmetric hydroformylation^[1], rhodium-catalyzed asymmetric hydrogenation of functionalized alkenes^[1], and ruthenium-catalyzed asymmetric hydrogenation of ketones^[2]. Research has shown that QuinaPhos-based transition metal catalysts show excellent activity and selectivity, comparable to some of the best among the 'last generation' of phosphine ligands (such as PhanePhos and MeBoPhoz).



(R_a, S_c)-QuinaPhos



(R_a, R_c)-QuinaPhos



QuinaPhos

FTE Based Development Services

Maximizing customers' financial resources is paramount in every project we undertake.

With our **Knowledge Based Screening** approach, you will benefit from the collective knowledge of decades of catalysis expertise. Our distinguished team of scientists target feasible, scalable solutions.

Capabilities

Global Research Group Employing

- 25 Fume Hoods
- 9 parallel hydrogenators
- single reactors - 25 ml – 2 liters up to 100 bar pressure

Range of Services

Feasibility

- milligram to gram scale
- catalysts and process identification

Optimization

- multi-gram

Scale-up

- gram to kilogram

QuinaPhos can be the precursor to a wide family of ligands thanks to:

Its modular synthesis (the phosphine group at C8, the alkyl or aryl substituent at C2, the chiral diol), starting from easily accessible 8-substituted quinolines and chiral diols;

The possibility of diastereoisomeric tuning (both central and axial chirality are present in the molecule and can give rise to matching/mismatching effects leading to different results depending on the requirements of the catalytic reaction).

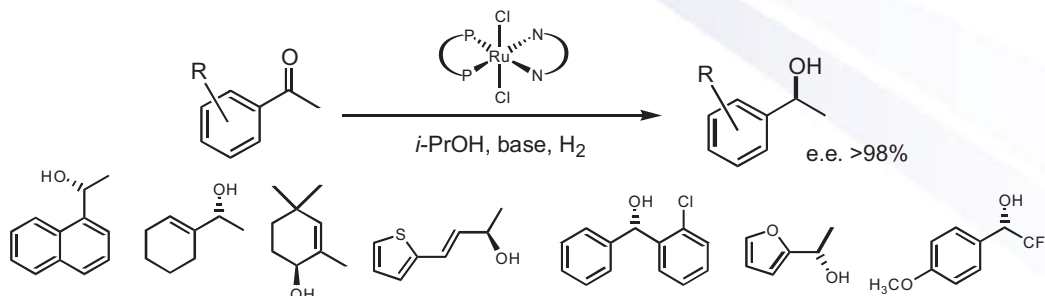
[1] G. Francio, F. Faraone, W. Leitner *Angewandte Chemie Int. Ed* 2000, 39, 1428

[2] S. Burk, G. Francio, W. Leitner *Chem. Commun.* 2005, 3460

Ketone Hydrogenation Technology

The reaction has excellent industrial applicability:

- high selectivity (>98% ee), activity (TON 1,000-100,000) and broad scope
- it can be applied to existing processes without changes in the synthetic strategy
- it has clear advantages over existing hydride reductions

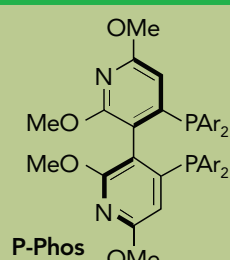


Asymmetric Hydrogenation Applications

Ru-catalyzed hydrogenation of C=C bonds (unsaturated acids)

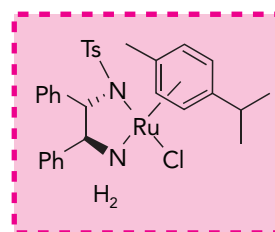
Available complexes

- Ru(arene)
- Ru(acac)₂
- Ru(methylallyl)₂



Transfer hydrogenation of C=O and C=N bonds

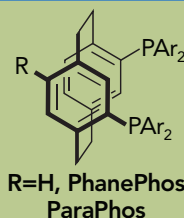
- Ketones
- Imines



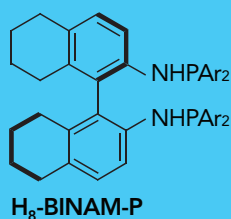
Rh-catalyzed hydrogenation of C=C bonds (enamides, dehydroaminoacids)

Available as

- Rh BF₄
- Rh-OTf
- Rh-Cl



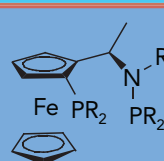
R=H, PhanePhos
ParaPhos



H₈-BINAM-P

Rh-catalyzed hydrogenation of C=O bonds

- Ketoesters
- Functionalized ketones



MeBoPhoz™

Ru-catalyzed hydrogenation of C=O bonds

- Bisphosphine Ru arene complexes
- Bisphosphine Ru diamines catalysts

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