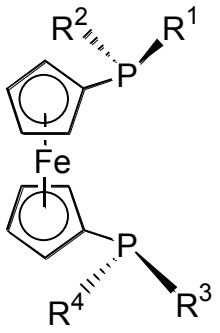
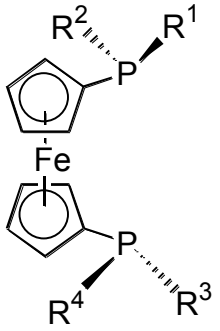
Claims

1. Diastereomer mixture comprising diastereomers of the formulae (**I.1**) and (**I.2**)



(**I.1**),



(**I.2**)

where

R^2, R^4 are each independently selected from -(C_1-C_{12})-alkyl, -(C_3-C_{12})-cycloalkyl, -(C_3-C_{12})-heterocycloalkyl, -(C_6-C_{20})-aryl;

the R^1, R^3 radicals are each a -(C_3-C_{20})-heteroaryl radical selected from furyl, thienyl, N-methyl-2-pyrrolyl, N-phenyl-2-pyrrolyl, N-(2-methoxyphenyl)-2-pyrrolyl, 2-pyrrolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, furazanyl, tetrazolyl, pyridyl, pyridazinyl, pyrimidyl, pyrazinyl, benzofuranyl, indolyl, isoindolyl, benzimidazolyl, quinolyl, and isoquinolyl;

R^1, R^3 may each independently be substituted by one or more substituents selected from

-(C_1-C_{12})-alkyl, -(C_3-C_{12})-cycloalkyl, -(C_3-C_{12})-heterocycloalkyl, -O-(C_1-C_{12})-alkyl, -O-(C_1-C_{12})-alkyl-(C_6-C_{20})-aryl, -O-(C_3-C_{12})-cycloalkyl, -S-(C_1-C_{12})-alkyl, -S-(C_3-C_{12})-cycloalkyl, -COO-(C_1-C_{12})-alkyl, -COO-(C_3-C_{12})-cycloalkyl, -CONH-(C_1-C_{12})-alkyl, -CONH-(C_3-C_{12})-cycloalkyl, -CO-(C_1-C_{12})-alkyl, -CO-(C_3-C_{12})-cycloalkyl, -N-[(C_1-C_{12})-alkyl]$_2$, -(C_6-C_{20})-aryl, -(C_6-C_{20})-aryl-(C_1-C_{12})-alkyl, -(C_6-C_{20})-aryl-O-(C_1-C_{12})-alkyl, -(C_3-C_{20})-heteroaryl, -(C_3-C_{20})-heteroaryl-(C_1-C_{12})-alkyl, -(C_3-C_{20})-heteroaryl-O-(C_1-C_{12})-alkyl, -COOH, -OH, -SO_3H, -NH_2, halogen;

and

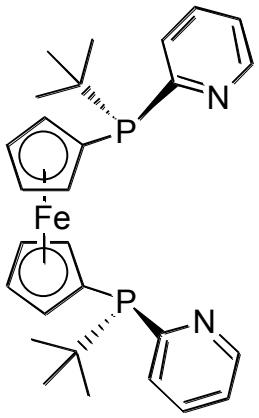
R^2, R^4, if they are -(C_1-C_{12})-alkyl, -(C_3-C_{12})-cycloalkyl, -(C_3-C_{12})-heterocycloalkyl or -(C_6-C_{20})-aryl, may each independently be substituted by one or more substituents selected from -(C_1-C_{12})-alkyl, -(C_3-C_{12})-cycloalkyl, -(C_3-C_{12})-heterocycloalkyl, -O-(C_1-C_{12})-alkyl, -O-(C_1-C_{12})-alkyl-(C_6-C_{20})-aryl, -O-(C_3-C_{12})-cycloalkyl, -S-(C_1-C_{12})-alkyl, -S-(C_3-C_{12})-cycloalkyl, -COO-(C_1-C_{12})-alkyl, -COO-(C_3-C_{12})-cycloalkyl, -CONH-(C_1-C_{12})-alkyl, -CONH-(C_3-C_{12})-cycloalkyl, -CO-(C_1-C_{12})-alkyl, -CO-(C_3-C_{12})-cycloalkyl, -N-[(C_1-C_{12})-alkyl]$_2$, -(C_6-C_{20})-aryl, -(C_6-C_{20})-aryl-(C_1-C_{12})-alkyl, -(C_6-C_{20})-aryl-O-(C_1-C_{12})-alkyl, -(C_3-C_{20})-heteroaryl, -(C_3-C_{20})-heteroaryl-(C_1-C_{12})-alkyl, -(C_3-C_{20})-heteroaryl-O-(C_1-C_{12})-alkyl, -COOH, -OH, -SO_3H, -NH_2, halogen,
where the molar ratio of (**I.1**) to (**I.2**) is in the range from 10:90 to 70:30.

2. Diastereomer mixture according to Claim 1,
where R^2, R^4 are each independently selected from -(C_1-C_{12})-alkyl, cyclohexyl and phenyl.

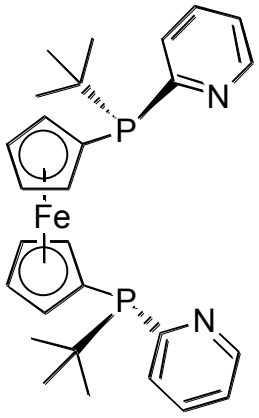
3. Diastereomer mixture according to any of Claims 1 to 2,
where R^1, R^3 are each pyridyl.

4. Diastereomer mixture according to any of Claims 1 to 3,
where R^1, R^3 are each identical radicals and R^2, R^4 are each identical radicals.

5. Diastereomer mixture according to any of Claims 1 to 4,
where the diastereomers **I.1** and **I.2** are compounds of the formula (**8.1**) and (**8.2**)

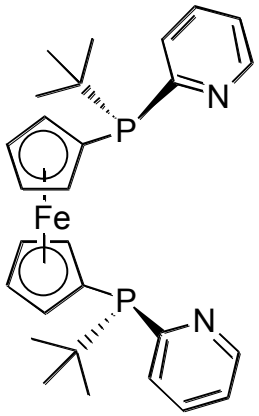


(**8.1**)

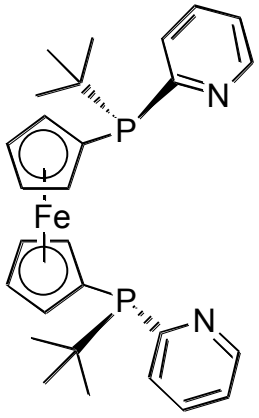


(**8.2**).

6. Diastereomer mixture comprising diastereomers of the formulae (**I.1**) and (**I.2**), where the diastereomers **I.1** and **I.2** are compounds of the formula (**8.1**) and (**8.2**)



(**8.1**)



(**8.2**).

7. Complex mixture comprising a first complex comprising Pd and a diastereomer of formula (**I.1**) according to any of Claims 1 to 6 and a second complex comprising Pd and a diastereomer of formula (**I.2**) according to any of Claims 1 to 6.

8. Process comprising the following process steps:
   a) initially charging an ethylenically unsaturated compound;
   b) adding a diastereomer mixture according to any of Claims 1 to 6 and a compound comprising Pd,
      or adding a complex mixture according to Claim 7;
   c) adding an alcohol;
   d) feeding in CO;
   e) heating the reaction mixture, with conversion of the ethylenically unsaturated compound to an ester.

9. Process according to Claim 8,
   wherein the ethylenically unsaturated compound comprises 2 to 30 carbon atoms and optionally one or more functional groups selected from carboxyl, thiocarboxyl, sulpho, sulphinyl, carboxylic anhydride, imide, carboxylic ester, sulphonic ester, carbamoyl, sulphamoyl, cyano, carbonyl, carbonothioyl, hydroxyl, sulphhydryl, amino, ether, thioether, aryl, heteroaryl or silyl groups and/or halogen substituents.

10. Process according to either of Claims 8 and 9,
    wherein the ethylenically unsaturated compound is selected from ethene, propene, 1-butene, *cis*- and/or *trans*-2-butene, isobutene, 1,3-butadiene, 1-pentene, *cis*- and/or *trans*-2-pentene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene, hexene, tetramethylethylene, heptene, 1-octene, 2-octene, di-n-butene, and mixtures thereof.

11. Process according to either of Claims 8 and 9,
    wherein the ethylenically unsaturated compound comprises 6 to 22 carbon atoms.

12. Process according to any of Claims 8 to 11,
    wherein the compound comprising Pd in process step b) is selected from palladium dichloride, palladium(II) acetylacetonate, palladium(II) acetate, dichloro(1,5-cyclooctadiene)palladium(II), bis(dibenzylideneacetone)palladium, bis(acetonitrile)dichloropalladium(II), palladium(cinnamyl) dichloride.

13. Process according to any of Claims 8 to 12,
wherein the alcohol in process step c) is selected from methanol, ethanol, 1-propanol, 1-butanol, 1-pentanol, 1-hexanol, 2-propanol, *tert*-butanol, 3-pentanol, cyclohexanol, phenol, and mixtures thereof.

14. Use of a compound according to any of Claims 1 to 6 or of a complex according to Claim 7 for catalysis of an alkoxycarbonylation reaction.