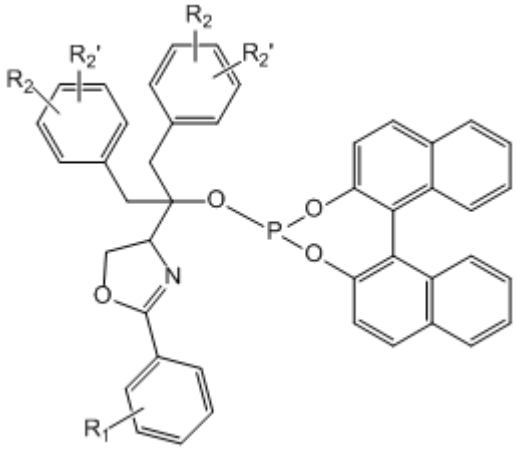
## CLAIMS

1. A catalyst for asymmetric hydrogenation of a carbon-carbon double bond-containing compound, comprising:

an iridium cation; and

a ligand of the following Formula 1, which is bonded to the iridium cation

[Formula 1]




wherein

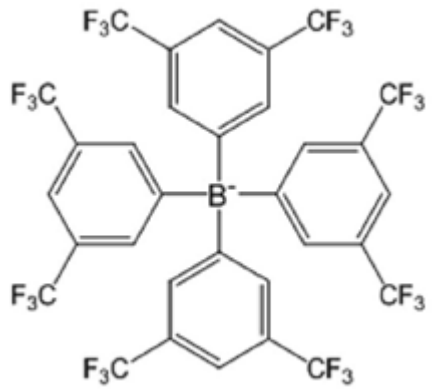
$R_1$ is a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group;

$R_2$ and $R_2'$ are each independently a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group; and

the substituent in the substituted alkyl group and substituted alkoxy group is a halogen atom, a straight or branched $C_1$-$C_3$ alkyl group, a straight or branched $C_1$-$C_3$ alkoxy group, and

wherein the catalyst further comprises a coordination anion of the following Formula 4:

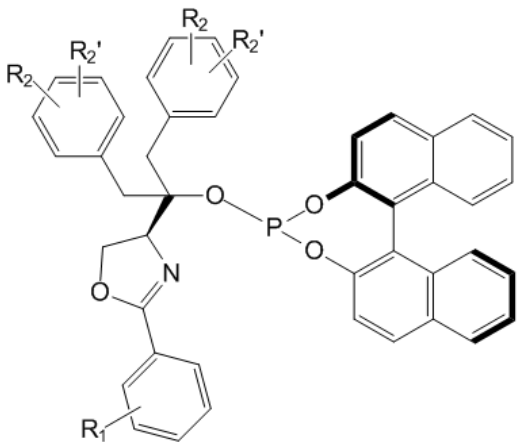
[Formula 4]



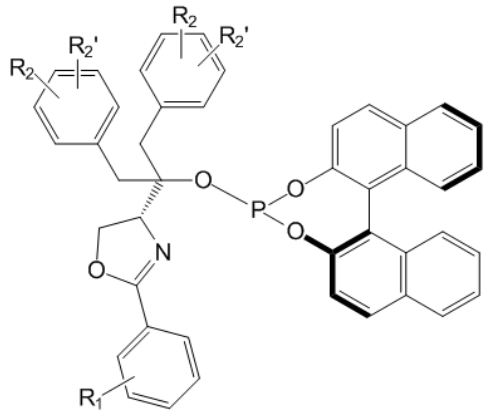
.

2. The catalyst of claim 1, wherein the ligand of Formula 1 is an enantiomeric compound represented by the following Formula 2a or 2b:

[Formula 2a]



[Formula 2b]



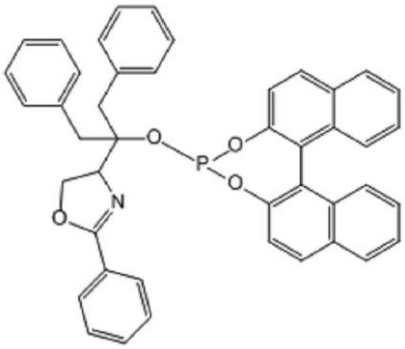

wherein

$R_1$ is a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group;

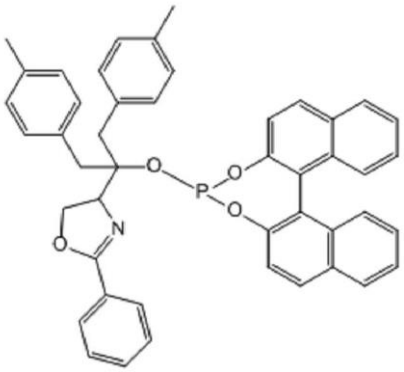
$R_2$ and $R_2'$ are each independently a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group; and

the substituent in the substituted alkyl group and substituted alkoxy group is a halogen atom, a straight or branched $C_1$-$C_3$ alkyl group, or a straight or branched $C_1$-$C_3$ alkoxy group.

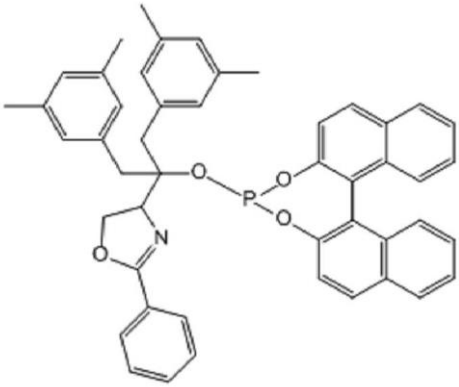
3. The catalyst of claim 1, wherein the ligand of Formula 1 is any one of the following compounds:



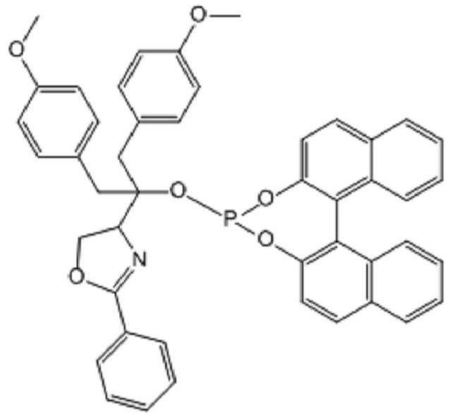
<Compound 1-1>



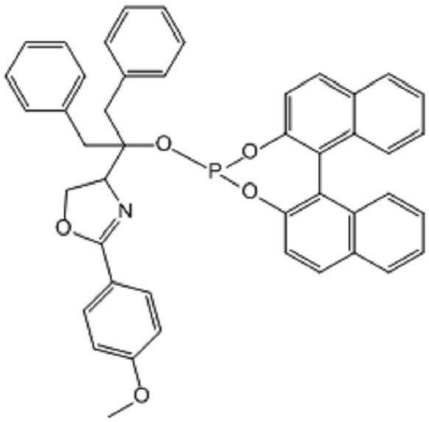
<Compound 1-2>



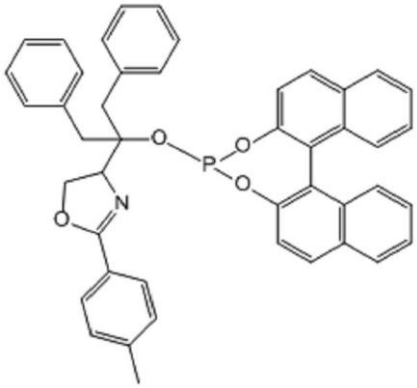
<Compound 1-3>



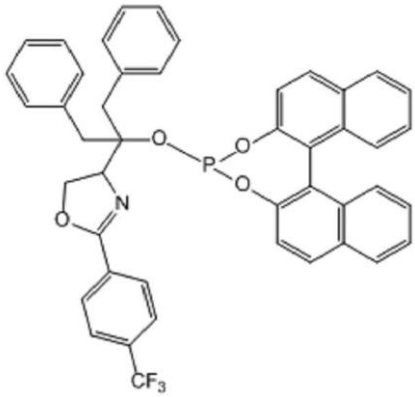
<Compound 1-4>



<Compound 1-5>



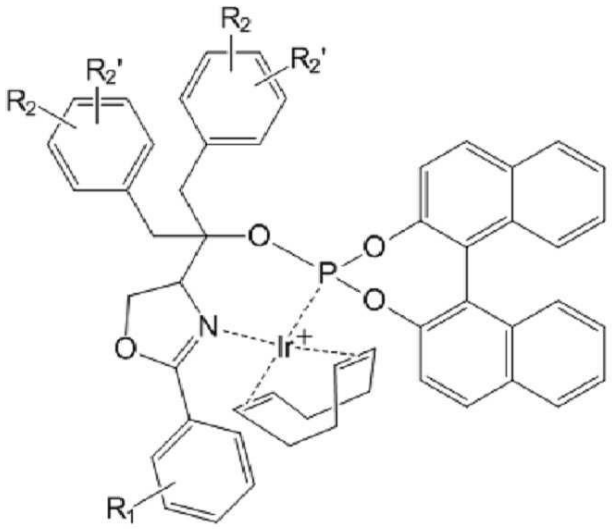
<Compound 1-6>



<Compound 1-7>

4. The catalyst of claim 1, wherein the catalyst comprises a complex of the following Formula 3:

[Formula 3]




wherein

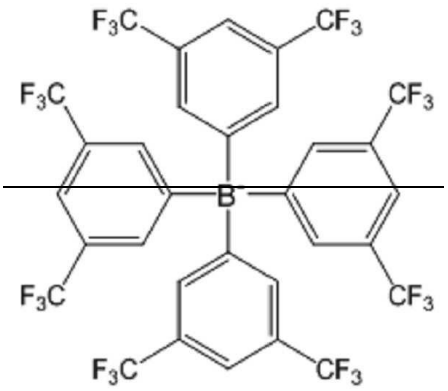
$R_1$ is a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group;

$R_2$ and $R_2'$ are each independently a hydrogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkyl group, or a substituted or unsubstituted, straight or branched $C_1$-$C_3$ alkoxy group; and

the substituent in the substituted alkyl group and substituted alkoxy group is a halogen atom, a straight or branched $C_1$-$C_3$ alkyl group, or a straight or branched $C_1$-$C_3$ alkoxy group.

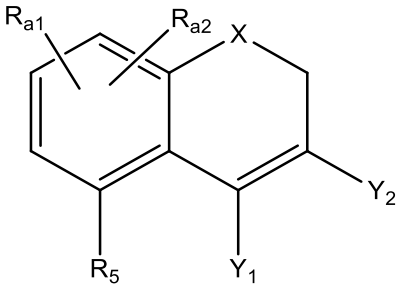
~~5. The catalyst of claim 1, wherein the catalyst further comprises a coordination anion of the following Formula 4:~~

~~[Formula 4]~~




~~6~~5. The catalyst of claim 1, wherein the carbon-carbon double bond-containing compound is represented by the following Formula 6:

[Formula 6]



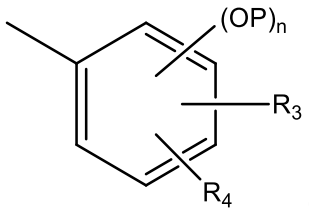

wherein

X is oxygen (O) or carbon (C);

$R_{a1}$ and $R_{a2}$ are each independently a hydrogen atom, a substituted or unsubstituted alkyl group having 1 to 3 carbon atoms, a substituted or unsubstituted alkoxy group having 1 to 3 carbon atoms, or a substituted or unsubstituted aryloxy group or aralkyloxy group having 6 to 15 carbon atoms, or

$R_{a1}$ and $R_{a2}$ together form a substituted or unsubstituted cyclic or heterocyclic group having 4 to 10 carbon atoms;

$R_5$ is a hydrogen atom or a $C_1$-$C_2$ alkyl group or a $C_1$-$C_2$ alkoxy group;

$Y_1$ and $Y_2$ are different from each other and are each independently a hydrogen atom, a substituted alkyl group having 1 to 3 carbon atoms, a substituted alkoxy group having 1 to 3 carbon atoms, or a 

group,

wherein

$R_3$ and $R_4$ are each independently a hydrogen atom, a hydroxyl group, a substituted or unsubstituted, straight or branched $C_1$-$C_6$ alkyl group, a halogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_6$ alkoxy group, a substituted or unsubstituted, straight or branched $C_1$-$C_4$ thioalkyl group, a substituted or unsubstituted allyloxy group, or a substituted or unsubstituted aryloxy group;

P represents a protecting group of a substituted or unsubstituted, straight or branched $C_1$-$C_4$ alkyl group, a substituted or unsubstituted benzyl group, a substituted or unsubstituted allyl group, a t-butyldimethylsilyl group, t-butyldiphenylsilyl group, a methylphenylsilyl group, a trimethylphenylsilyl group, $MeSO_2$, or p-$TsSO_2$;

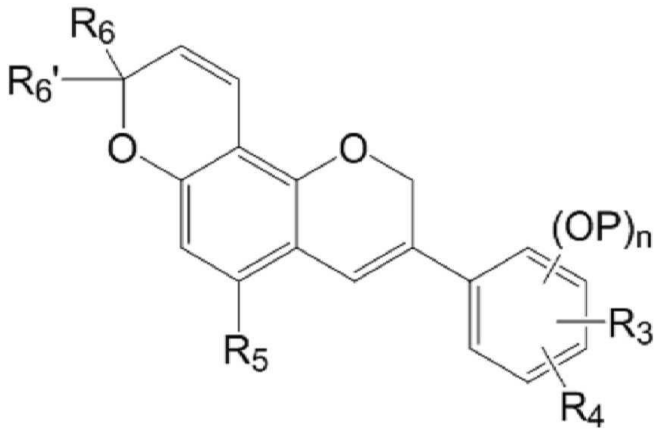
n is 1 to 3;

when OP is plural in number, they are the same or different; and

the substituent in the substituted alkyl group, substituted alkoxy group, substituted thioalkyl group, substituted aryloxy group, substituted aralkyloxy group, substituted cyclic group and substituted heterocyclic group is a halogen atom, a straight or branched $C_1$-$C_5$ alkyl group, a straight or branched $C_1$-$C_5$ alkoxy group, or a straight or branched $C_1$-$C_3$ thioalkyl group.

~~7~~6. The catalyst of claim ~~6~~5, wherein the carbon-carbon double bond-containing compound is a compound represented by the following Formula 7:

[Formula 7]




wherein

$R_3$ and $R_4$ are each independently a hydrogen atom, a hydroxyl group, a substituted or unsubstituted, straight or branched $C_1$-$C_6$ alkyl group, a halogen atom, a substituted or unsubstituted, straight or branched $C_1$-$C_6$ alkoxy group; a substituted or unsubstituted, straight or branched $C_1$-$C_4$ thioalkyl group; a substituted or unsubstituted allyloxy group, or a substituted or unsubstituted aryloxy group;

$R_5$ is a hydrogen atom, a $C_1$-$C_2$ alkyl group or a $C_1$-$C_2$ alkoxy group;

$R_6$ and $R_6$' are each independently a hydrogen atom or a $C_1$-$C_6$ alkyl group;

P represents a protecting group of a substituted or unsubstituted, straight or branched $C_1$-$C_4$ alkyl group, a substituted or unsubstituted benzyl group, a substituted or unsubstituted allyl group, a t-butyldimethylsilyl group, t-butyldiphenylsilyl group, a methylphenylsilyl group, a trimethylphenylsilyl group, $MeSO_2$, or p-$TsSO_2$;

n is 1 to 3;

when OP is plural in number, they are the same or different; and

the substituent in the substituted alkyl group, substituted alkoxy group and substituted thioalkyl group is a halogen atom, a straight or branched $C_1$-$C_5$ alkyl group, a straight or branched $C_1$-$C_5$ alkoxy group, or a straight or branched $C_1$-$C_3$ thioalkyl group.