FREE DESIGN OF CHIRAL DIPHOSPHINE CHELATING LIGANDS BY ASSEMBLING FIVE-MEMBERED AROMATIC HETEROCYCLES

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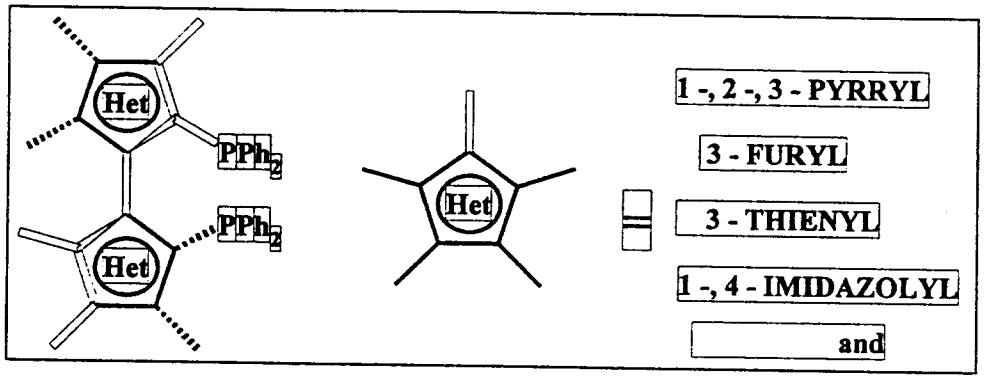
CHIRAL DIPHOSPHINES WITH ATROPISOMERIC FIVE-MEMBERED BIHETEROAROMATIC BACKBONE

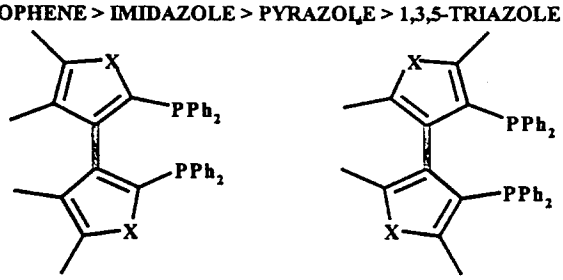


1 - MODULATION OF ELECTRONIC AVAILABILITY OF PHOSPHORUS

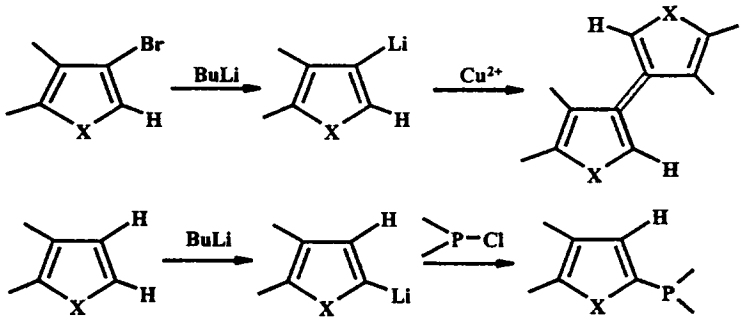
DIFFERENT ELECTRONIC DENSITY OF THE DIFFERENT POSITIONS

DIFFERENT ELECTRONIC AVAILABILITY OF FIVE-MEMBERED AROMATIC HETEROCYCLES :

PYRROLE > FURANE > THIOPHENE > IMIDAZOLE > PYRAZOLE > 1,3,5-TRIAZOLE

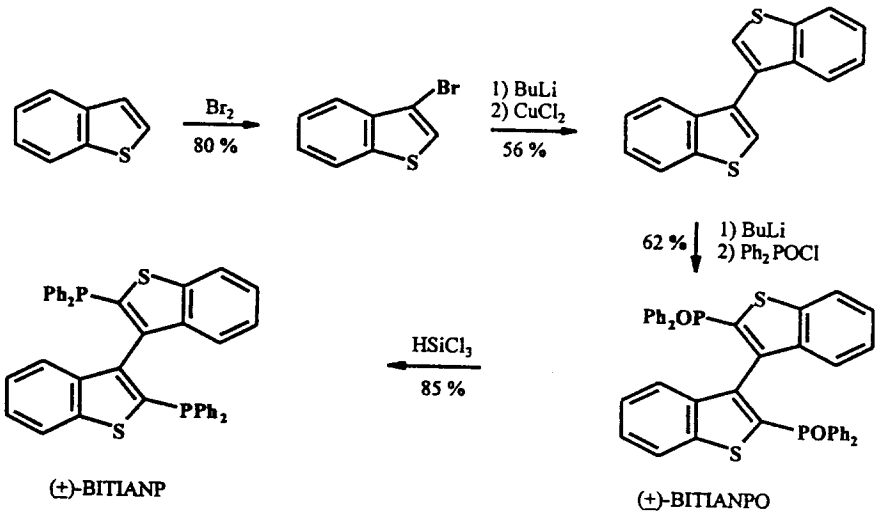


2 - SYNTHETIC ACCESSIBILITY



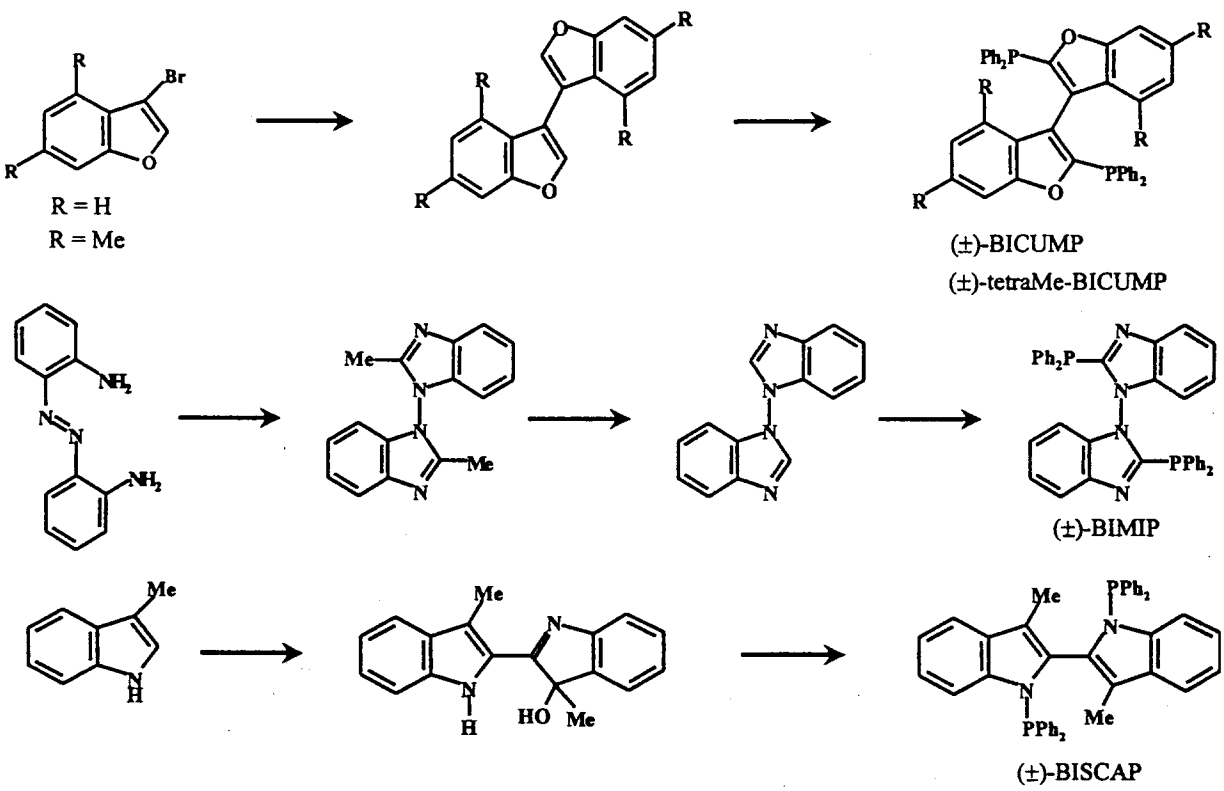
3 - NEW GEOMETRY OF CHELATE RING

SYNTHESIS OF DIPHOSPHINE LIGANDS WITH 3,3'-BIBENZO[b]THIOPHENE BACKBONE

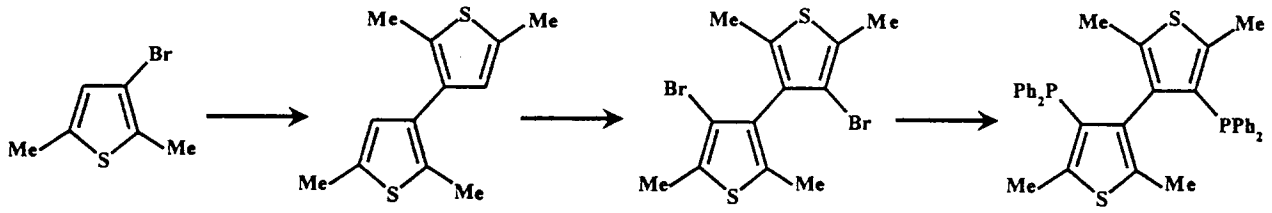


J. Chem. Soc., Chem. Commun., 1995, *685; J. Org. Chem.*, 1996, 6244

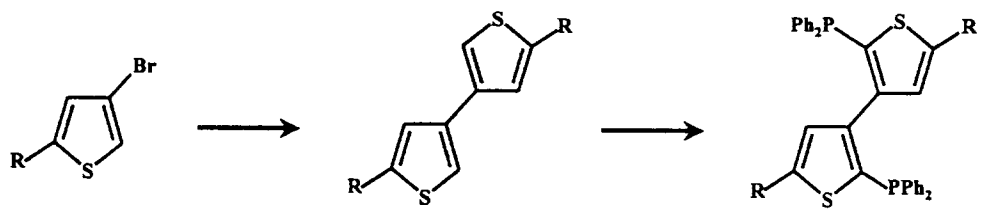
SYNTHESIS OF DIPHOSPHINE LIGANDS WITH 3,3'- BIBENZO[b]FURANE; 1,1'- BIBENZIMIDAZOLE AND 2,2'- BIINDOLE BACKBONE



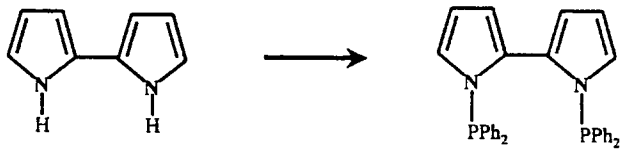
SYNTHESIS OF DIPHOSPHINE LIGANDS WITH 3,3'- BITHIOPHENE AND 2,2'- BIPYRROLE BACKBONE



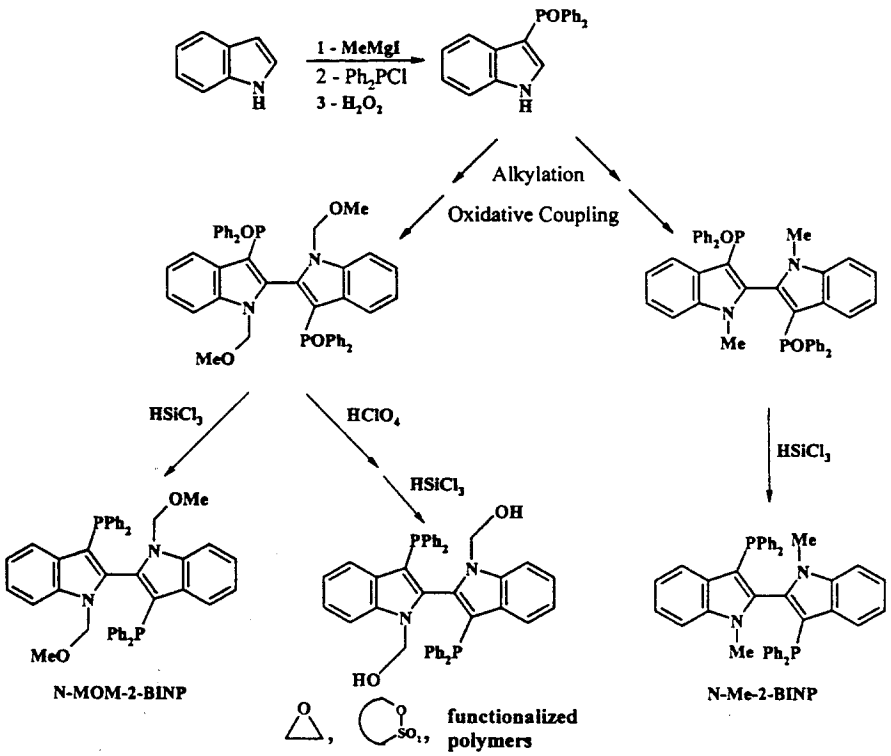
(±)-tetraMe-BITIOP



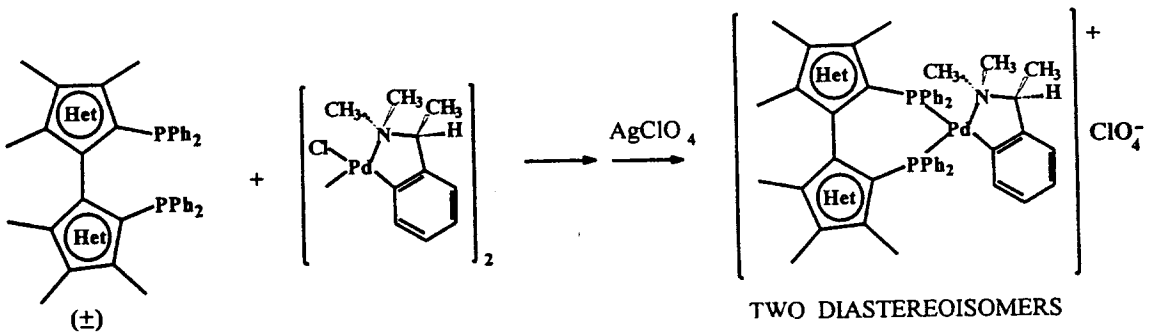
R = H BITIOP
R = Me diMe-BITIOP



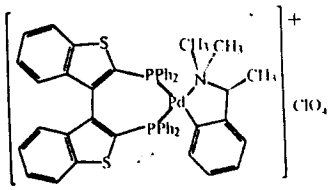
SYNTHESIS OF DIPHOSPHINE LIGANDS WITH 2,2'-BIINDOLE BACKBONE

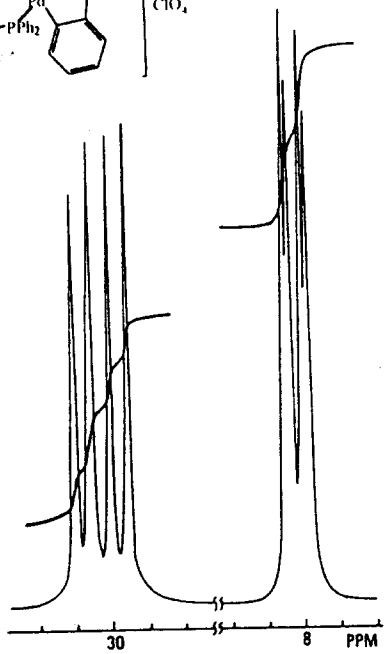


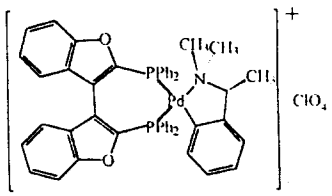
EVALUATION OF CONFIGURATIONAL STABILITY OF C_2 SYMMETRY DIPHOSPHINES BY ^{31}P NMR SPECTROSCOPY

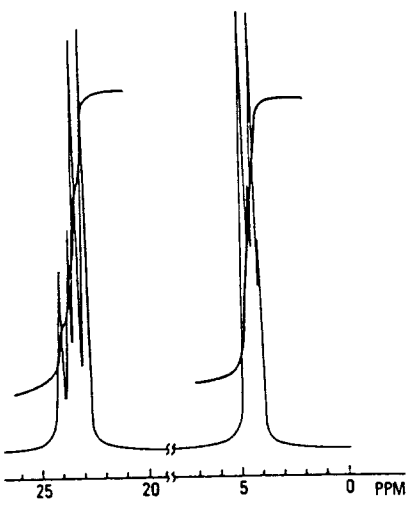


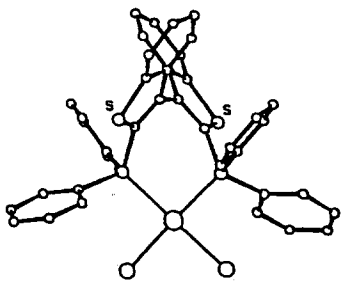
TWO DIASTEREOISOMERS



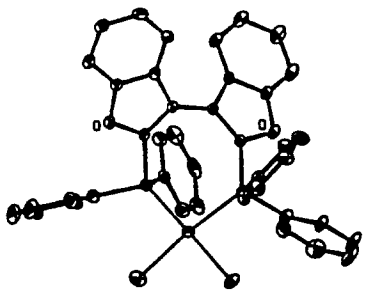




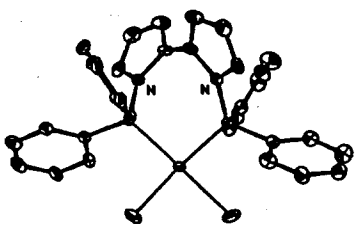




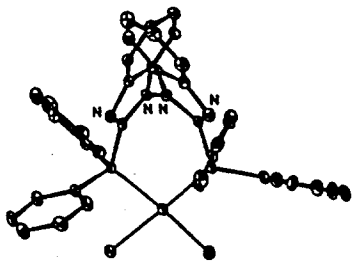
BITIANP



BICUMP

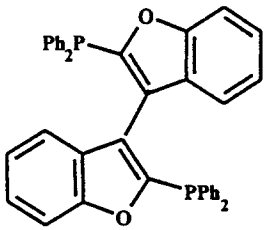


BIPIRP



BIMIP

CONFIGURATIONALLY UNSTABLE DIPHOSPHINES



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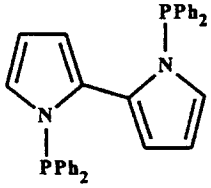

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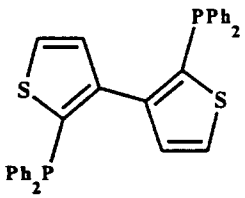
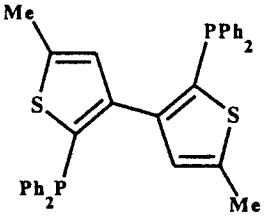
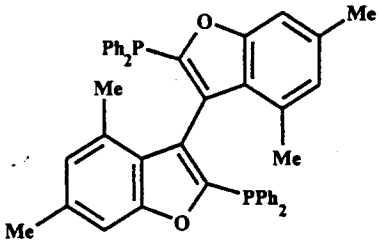


BITIOP

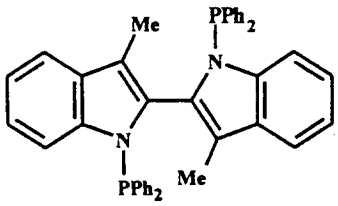


diMe-BITIOP

DIPHOSPHINES RESOLVED ON ANALYTICAL SCALE (CHIRAL HPLC)

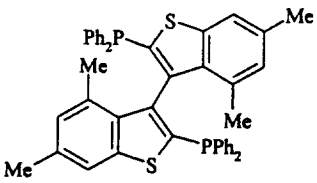


tetraMe-BICUMP

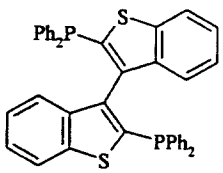


BISCAP

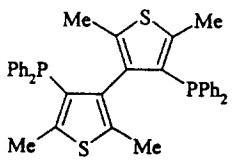
LARGE-SCALE RESOLVED DIPHOSPHINE LIGANDS



tetraMe-BITIANP



BITIANP



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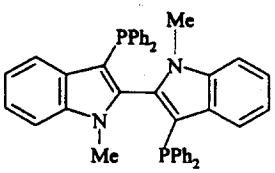
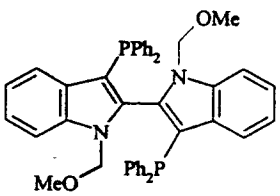


N-Me-2-BINP



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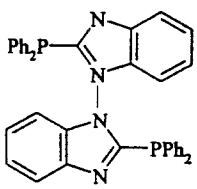
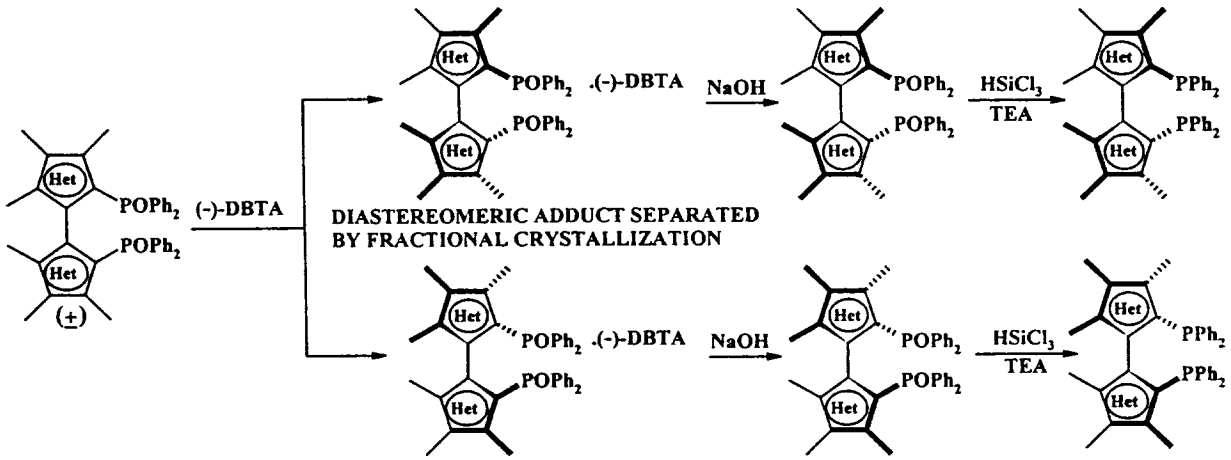
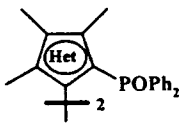
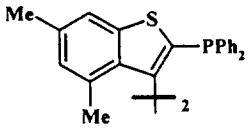
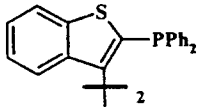
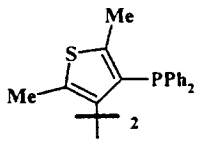
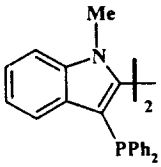
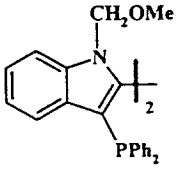
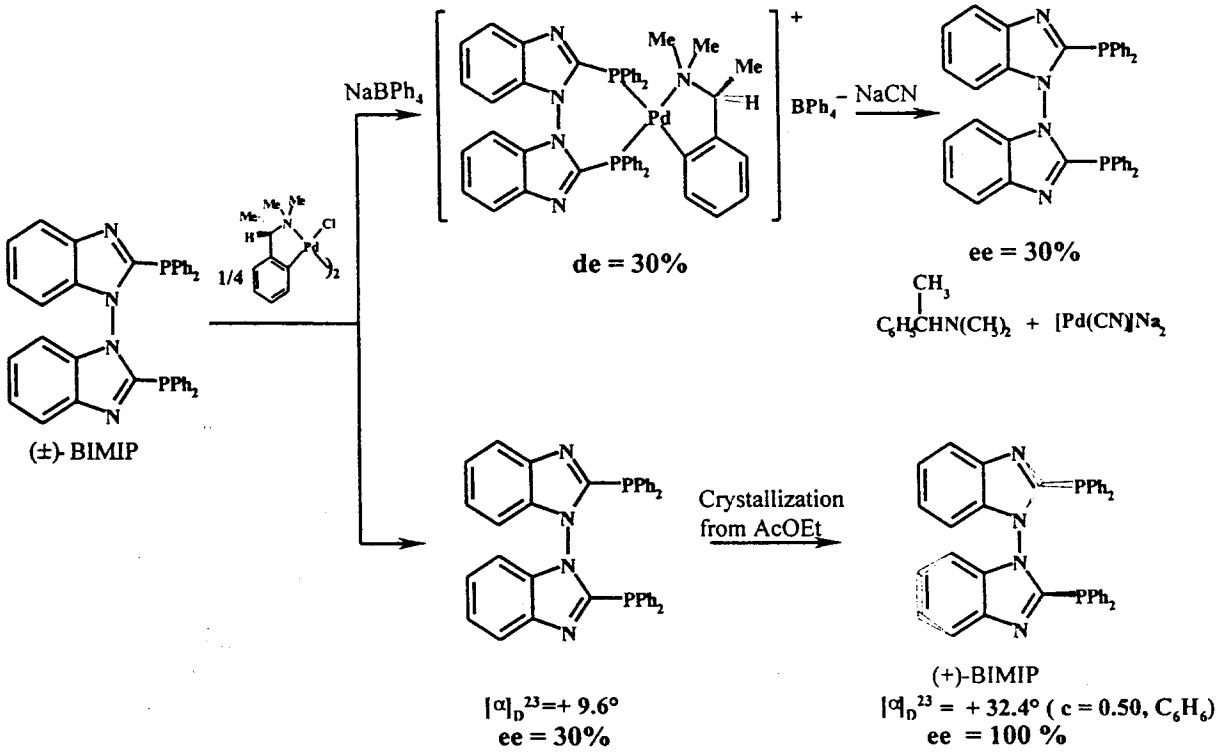


BIMIP

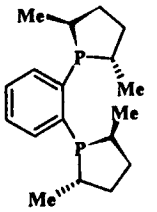
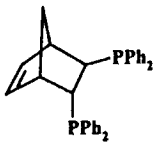
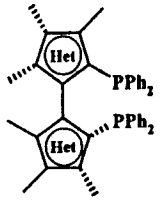
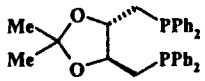
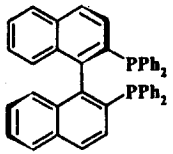
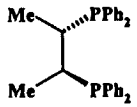
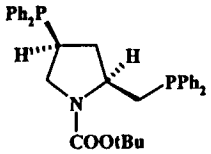


					
$[\alpha]_D^{25}$	± = 266° (c = 0.44, C_6H_6)	± = 193° (c = 0.50, C_6H_6)	± = 27° (c = 0.48, C_6H_6)	± = 121° (c = 0.50, C_6H_6)	± = 74° (c = 0.48, EtOH)

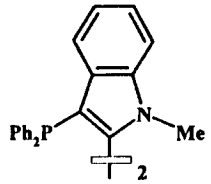
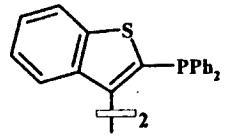
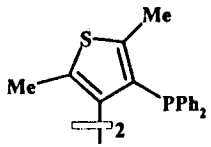
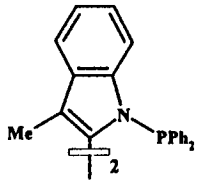
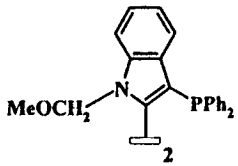
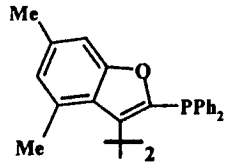
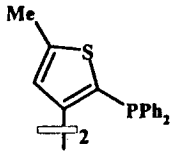
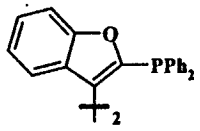
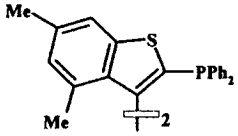
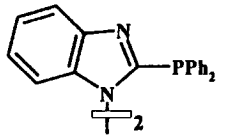
RESOLUTION OF (±)-BIMIP



EVALUATION OF ELECTRONIC AVAILABILITY AT PHOSPHORUS BY ELECTROCHEMICAL OXIDATIVE POTENTIAL

LIGAND	E° (Volt)	LIGAND	E° (Volt)
 Me-DuPHOS	0.39	 NORPHOS	0.83
	0.56 1.15	 DIOP	0.97
 BINAP	0.63	 CHIRAPHOS	0.97
p-Tol-BINAP	0.65	 BPPM	0.99

EVALUATION OF ELECTRONIC AVAILABILITY AT PHOSPHORUS BY ELECTROCHEMICAL OXIDATIVE POTENTIAL

LIGAND	E° (Volt)	LIGAND	E° (Volt)
 N-Me-2-BINP	0.52	 BITIANP	0.90
 tetraMe-BITIOP	0.57	 BISCAP	0.90
 N-MOM-2-BINP	0.60	 tetraMe-BICUMP	0.91
 diMe-BITIOP	0.70	 BICUMP	1.03
 tetraMe-BITIANP	0.76	 BIMIP	1.15

ASYMMETRIC HYDROGENATION OF ETHYL 3-OXOBUTANOATE

Catalyst	S/C	H_2 Kg/cm²	Temp °C	Time h	% ee	Conf	%Yield
$[RuCl_2((S)\text{-BITIANP})(dmf)]_n$	1000	100	70	**2**	**>99**	S	91
$[RuCl_2((R)\text{-tetraMe-BITIANP})(dmf)]_n$	1000	100	70	**2**	**>99**	R	95
$[RuCl_2((R)\text{-BINAP})(dmf)]_n$	1950	100	100	**0.5**	**98**	R	97
$[RuCl_2((R)\text{-tetraMe-BITIOP})(dmf)]_n$	1000	100	70	**2**	**97**	R	100
$[RuCl_2((R)\text{-N-Me-2-BINP})(dmf)]_n$	1000	100	45	**0.5**	**86**	R	100
$[RuCl_2((S)\text{-N-Me-2-BINP})(dmf)]_n$	1114	50	10	**30**	**95**	S	100
[RuI((S)-BINAP)(p-cymene)]I	2500	100	30	**35**	**99**	S	97
[RuI((S)-N-Me-2-BINP)(p-cymene)]I	2480	100	32	**4.5**	**94**	S	100

ASYMMETRIC HYDROGENATION OF ETHYL BENZOYLACETATE

Catalyst	S/C	H_2 kg/cm²	Temp °C	Time h	% ee	Conf	% Yield
$[RuCl_2((S)\text{-tetraMe-BITIANP})(dmf)]_n$	1000	100	25	**100**	**90**	R	92
$[RuBr_2((R)\text{-BINAP})]$	760	91	23-30	**106**	**85**	S	>99.5
$[RuCl_2((R)\text{-tetraMe-BITIOP})(dmf)]_n$	257	100	50	**2.25**	**93**	S	100
$[RuCl_2((S)\text{-N-Me-2-BINP})(dmf)]_n$	251	95	45	**0.8**	**89**	R	98

ASYMMETRIC HYDROGENATION OF METHYL PHENYL GLYOXYLATE

Catalyst	S/C	H_2 kg/cm^2	Temp °C	Time h	% ee	Conf	%Yield
$[RuCl_2((S)\text{-tetraMe-BITIANP})(dmf)]_n$	1000	100	25	**100**	**78**	S	90
$[RuCl((S)\text{-BINAP})(C_6H_6)]Cl$ aq HBF_4	540	100	30	**99**	**89**	S	100
$[RuCl((S)\text{-tetraMe-BITIOP})(C_6H_6)]Cl$ aq HBF_4	520	100	25	**72**	**90**	S	100
$[RuCl((R)\text{-N-Me-2-BINP})(C_6H_6)]Cl$ aq HBF_4	200	100	30	**26**	**89**	R	100
$[RuCl((S)\text{-N-Me-2-BINP})(C_6H_6)]Cl$ aq HBF_4	560	100	30	**12**	**81**	S	100

ASYMMETRIC HYDROGENATION OF METHYL PIRUVATE

Catalyst	S/C	H_2 kg /cm^2	Temp °C	Time h	% ee	Conf	%Yield
$[RuCl_2((S)\text{-tetraMeBITIANP})(dmf)]_n$	600	100	25	**100**	**88**	S	100
$[RuCl((S)\text{-BINAP})(C_6H_6)]Cl$	580	100	30	**95**	**88**	S	100

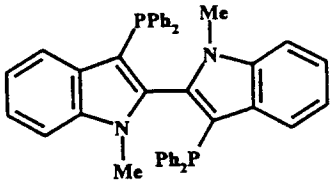
ASYMMETRIC HYDROGENATION OF TIGLIC ACID

Catalyst	S/C	H_2 kg/cm^2	Temp °C	Time h	% ee	Conf	%Yield
$[Ru((R)\text{-BITIANP})(OAc)_2]$	500	10	25	44	**88**	R	100
$[Ru((S)\text{-tetraMe-BITIANP})(OAc)_2]$	500	10	25	85	**89**	S	100
$[Ru((S)\text{-tetraMe-BITIANP})(p\text{-cym})I]I$	500	10	25	88	**92**	S	100
$[Ru((S)\text{-BINAP})(C_6H_5)Cl]BF_4$	1000	4	20	92	**89**	S	89
$[Ru((R)\text{-tetraMe-BITIOP})(Me\text{-allyl})_2]$	3000	10	25	11	**94**	R	100

ASYMMETRIC HYDROGENATION OF ATROPIC ACID

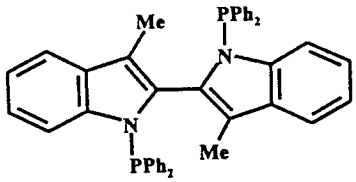
$[Ru((R)\text{-BITIANP})(OAc)_2]$	300	100	25	4	86	R	100
$[Ru((S)\text{-tetraMe-BITIANP})(OAc)_2]$	300	100	25	4	90	S	100
$[Ru((R)\text{-tetraMe-BITIOP})(Me\text{-allyl})_2]$	160	150	25	2	92	R	100
$[Ru((R)\text{-N-Me-2-BINP})(OAc)_2]$	50	102	5	4	74	R	100

HYDROGENATION OF ETHYL 3-OXOBUTANOATE WITH $RuCl_2$-N-Me-2-BINP AND $RuCl_2$-BISCAP



(±)-N-Me-2-BINP

$k = 1.42 \times 10^{-4}$ sec^{-1}

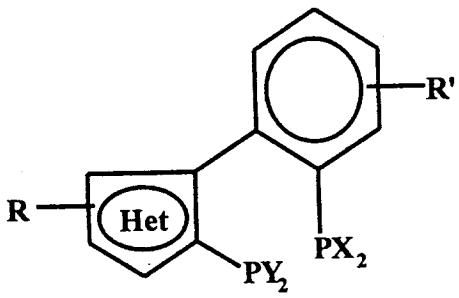


(±)-BISCAP

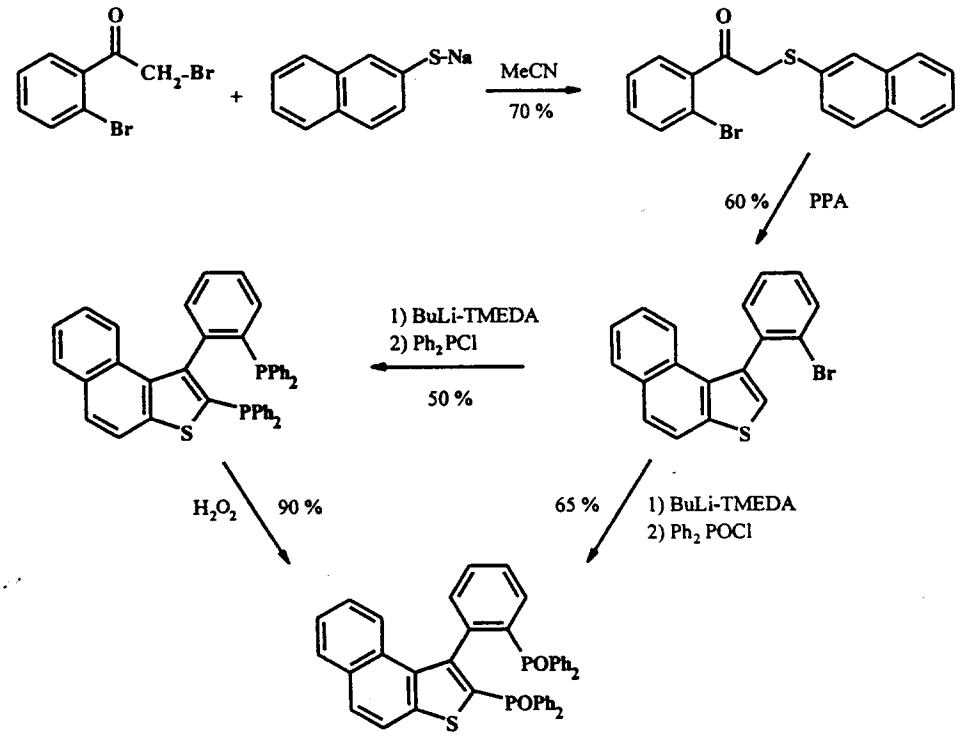
$k = 2.35 \times 10^{-6}$ sec^{-1}

SOLVENT : MeOH- 2.5 % H_2O
H_2 : 100 atm
t : 40 °C
S/C : 1000

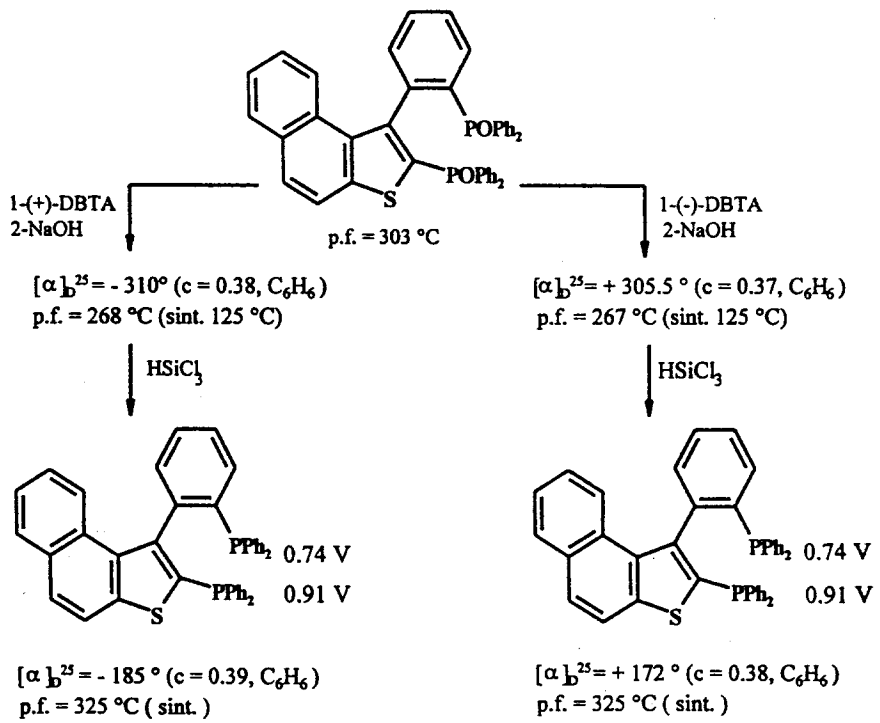
CHIRAL DIPHOSPHINES WITH FIVE-MEMBERED HETEROAROMATIC - SIX-MEMBERED CARBOCYCLIC AROMATIC ATROPISOMERIC BACKBONE



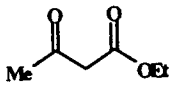
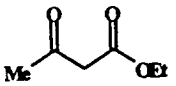
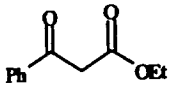
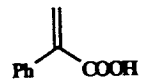
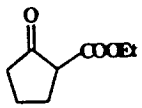
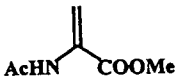
SYNTHESIS OF A C_1 DIPHOSPHINE WITH MIXED FIVE-MEMBERED HETEROAROMATIC - SIX-MEMBERED CARBOCYCLIC AROMATIC BACKBONE



RESOLUTION OF A C_1 DIPHOSPHINE WITH MIXED FIVE-MEMBERED HETEROAROMATIC- SIX-MEMBERED CARBOCYCLIC AROMATIC BACKBONE



ASYMMETRIC HYDROGENATION WITH A C_1 DISPHOSPHINE (L)

Substrate	Catalyst	S/C	H_2 kg /cm^2	Temp °C	Time h	de %	ee %	Conf
	$[RuCl_2(+)\text{-}(L)(dmf)]_n$	205	100	70	1.25	_	88	R
	$[RuCl_2(+)\text{-}(L)(dmf)]_n$	289	100	40	3.5	_	96	R
	$[RuCl_2(+)\text{-}(L)(dmf)]_n$	240	100	55	6	_	73	S
	$[(Ru(+)\text{-}(L)(Me\text{-}allyl)_2]$	170	52	45	1.5	_	65	R
	$[RuCl_2(-)\text{-}(L)(dmf)]_n$	1000	100	40	8	74 *(anti)*	97	1S, 2S
	(+)-(L)/$[Rh(COD)Cl]_2$	200	3.7	25	62	-	72	S

NEW C_1 SYMMETRY DIPHOSPHINE LIGANDS