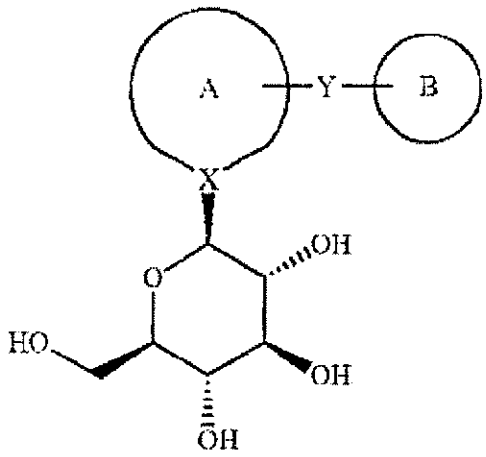
We claim:

1. A process for the preparation of compounds of formula (I)

(I)



wherein Ring A and Ring B are one of the following:

(1) Ring A is an optionally substituted unsaturated monocyclic heterocyclic ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, an optionally substituted unsaturated fused heterobicyclic ring, or an optionally substituted benzene ring; or

(2) Ring A is an optionally substituted benzene ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, or an optionally substituted unsaturated fused heterobicyclic ring wherein Y is linked to the heterocyclic ring of the fused heterobicyclic ring; or

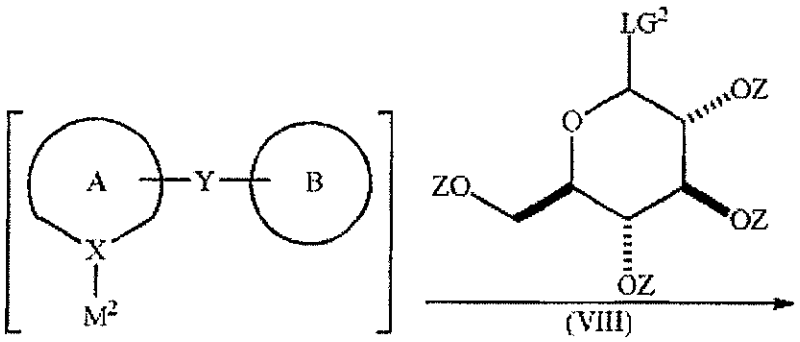
(3) Ring A is an optionally substituted unsaturated fused heterobicyclic ring, wherein the sugar moiety X-(sugar) and the moiety —Y-(Ring B) are both on the same heterocyclic ring of the fused heterobicyclic ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, an optionally substituted unsaturated fused heterobicyclic ring, or an optionally substituted benzene ring;

X is a carbon atom;

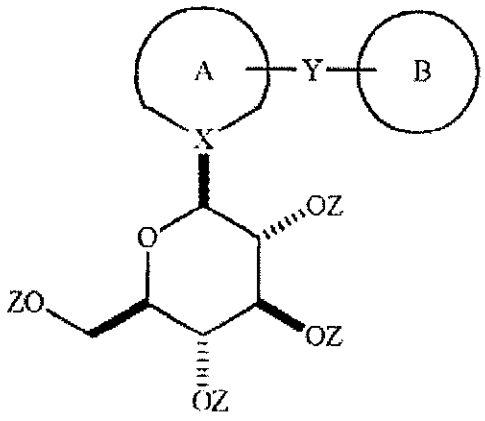
Y is $—(CH_2)_n—$; wherein n is 1 or 2;

provided that in Ring A, X is part of an unsaturated bond;

or a pharmaceutically acceptable salt or solvate thereof; comprising

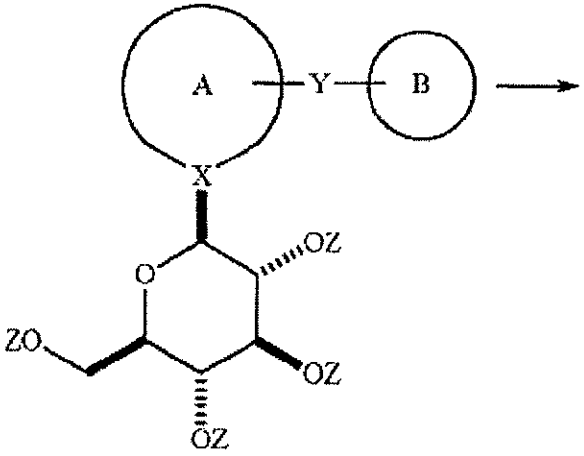


(VII) (VIII)

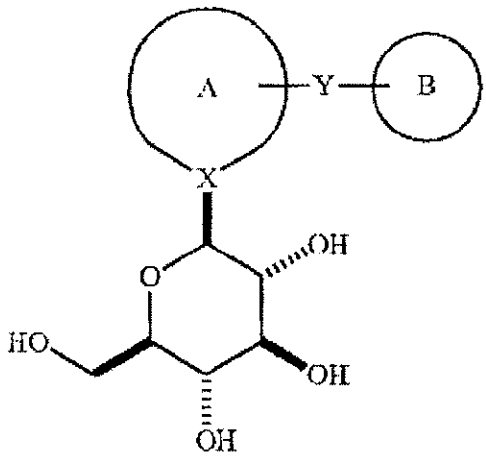


(IX)

reacting a compound of formula (VII), wherein M^2 is a zinc species, with a compound of formula (VIII), wherein each Z is pivaloyl and wherein LG^2 is bromo; in a mixture of an ether solvent and a hydrocarbon solvent; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; at a temperature in the range of from about 60° C. to about 95° C.; to yield the corresponding compound of formula (IX);



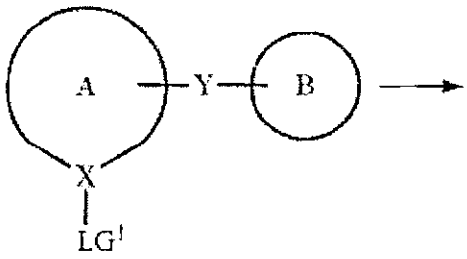
(IX)



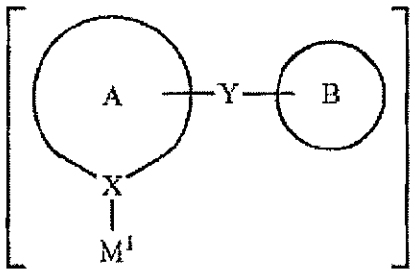
(I)

de-protecting the compound of formula (IX); to yield the corresponding compound of formula (I).

2. A process as in claim 1, further comprising

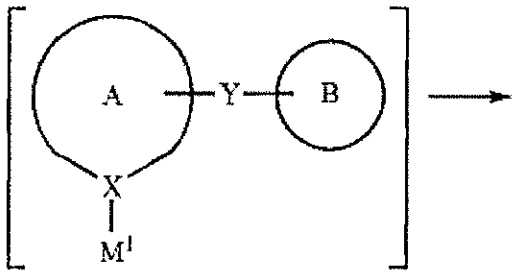


(V)

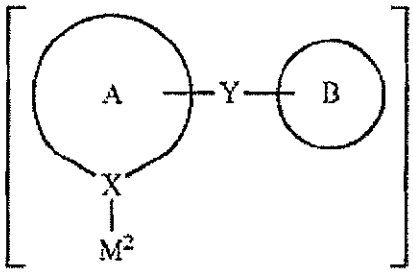


(VI)

reacting a compound of formula (V), wherein LG^1 is a leaving group, with an organo-lithium reagent; in a mixture of an ether solvent and a hydrocarbon solvent; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; to yield the corresponding compound of formula (VI). wherein M^1 is lithium;



(VI)



(VII)

reacting the compound of formula (VI) with a zinc salt or an amine complex of zinc halide; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; in a mixture of an ether solvent and a hydrocarbon solvent; to yield the corresponding compound of formula (VII).

3. A process as in claim 1, wherein M^2 is ZnBr.

4. A process as in claim 1, wherein the compound of formula (VIII) is present in an amount in the range of from about 1.0 to about 1.1 molar equivalents.

5. A process as in claim 1, wherein the hydrocarbon solvent is toluene.

6. A process as in claim 2, wherein the organo-lithium reagent is n-hexyl lithium; and wherein the n-hexyl lithium is present in an amount in the range of from about 1.0 to about 1.2 molar equivalents.

7. A process as in claim 2, wherein the hydrocarbon solvent is toluene.

8. A process as in claim 2, wherein the zinc salt is selected from the group consisting of zinc dibromide ($ZnBr_2$), zinc diiodide (ZnI_2) and zinc ditriflate; and wherein the amine complex of zinc halide is selected from the group consisting of pyridine zinc bromide complex and N-methylmorpholine zinc bromide complex.

9. A process as in claim 2, wherein the compound of formula (VI) is reacted with a zinc salt; wherein the zinc salt is zinc dibromide and wherein the zinc dibromide is present in an amount in the range of from about 0.33 to about 1.0 molar equivalents.

10. A process as in claim 1, wherein

X is a carbon atom;

Ring A is selected from the group consisting of 4-methylphenyl and 4-chlorophenyl;

Y is —CH_2— and is bound at the 3-position of Ring A; and

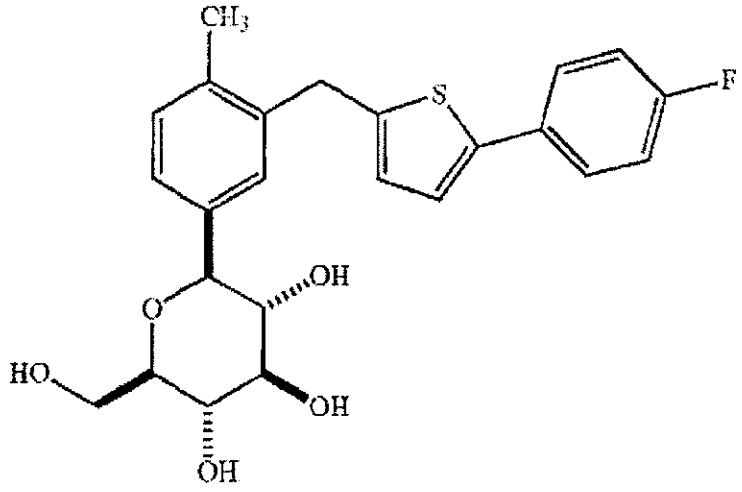
Ring B is selected from the group consisting of 2-(5-(4-fluorophenyl)-thienyl) and 2-(5-(6-fluoro-pyrid-3-yl) thienyl).

11. A process as in claim 1, wherein X is a carbon atom; Ring A is 4-methyl-phenyl; Y is —CH_2— and is bound at the 3-position of Ring A; and

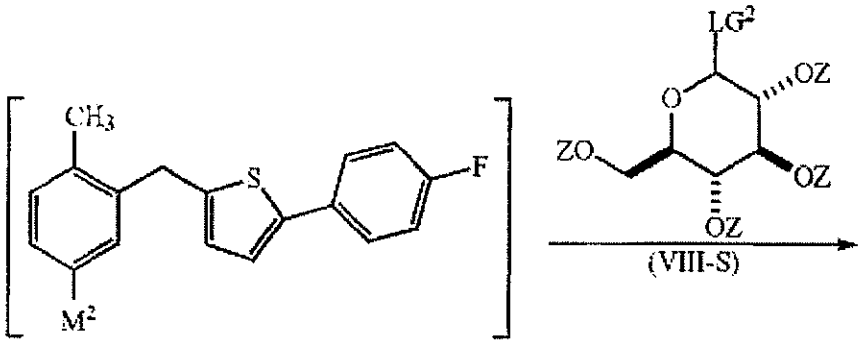
Ring B is 5-(4-fluorophenyl)-thien-5-yl.

12. A process for the preparation of a compound of formula (I-S)

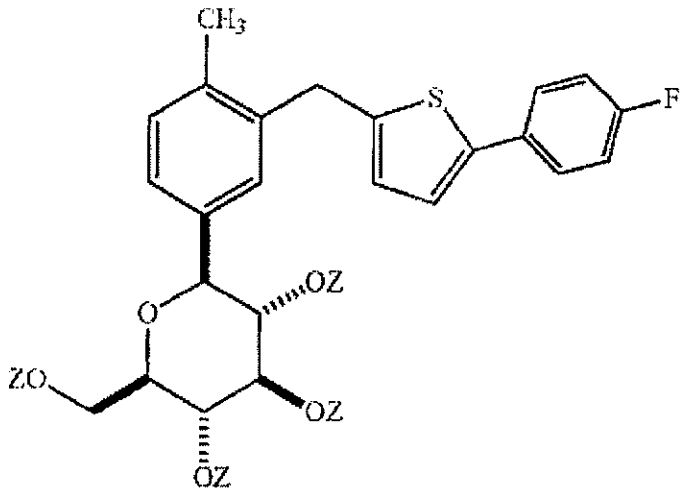
(I-S)



or solvate thereof; comprising

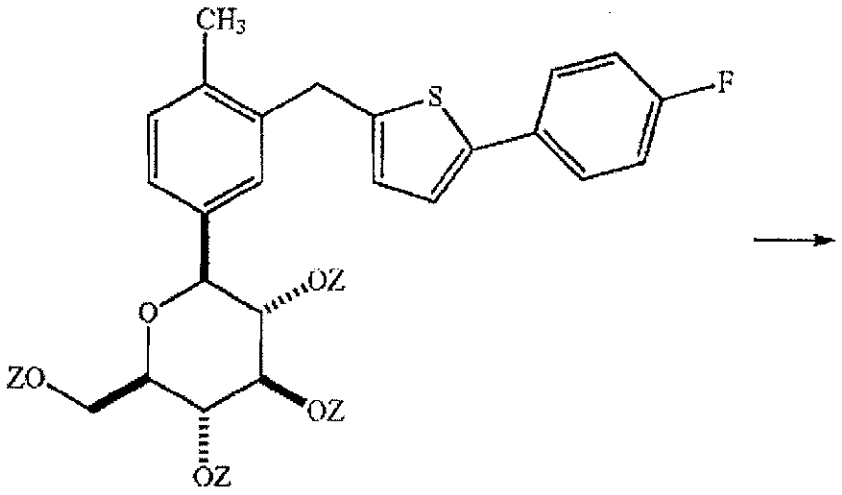


(VII-S) (VIII-S)

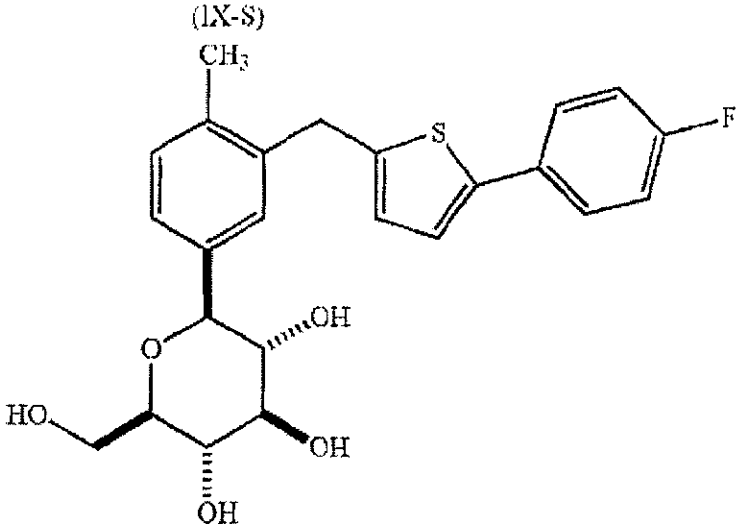


(IX-S)

reacting a compound of formula (VII-S), wherein M^2 is a zinc species, with a compound of formula (VIII-S), wherein each Z is pivaloyl and wherein LG^2 is bromo; in a mixture of an ether solvent and a hydrocarbon solvent; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; at a temperature in the range of from about 60° C. to about 95° C.; to yield the corresponding compound of formula (IX-S);



(IX-S)



(I-S)

de-protecting the compound of formula (IX-S); to yield the corresponding compound of formula (I-S).

13. A process as in claim **12**, wherein M^2 is ZnBr.

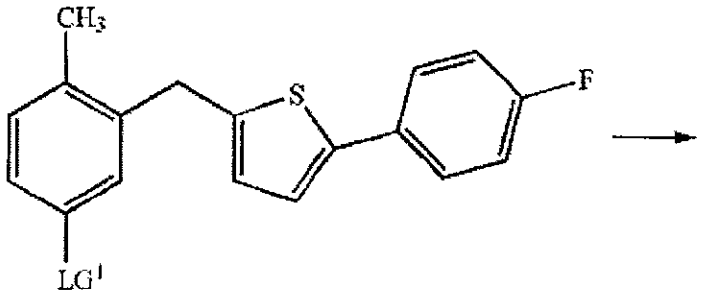
14. A process as in claim **12**, wherein the compound of formula (VIII-S) is present in an amount in the range of from about 0.8 to about 1.25 molar equivalents.

15. A process as in claim **14**, wherein the compound of formula (VIII-S) is present in an amount in the range of from about 1.0 to about 1.1 molar equivalents.

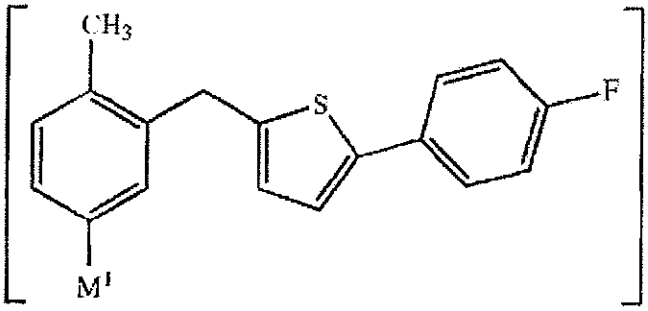
16. A process as in claim **12**, wherein the hydrocarbon solvent is toluene.

17. A process as in claim **12**, wherein the compound of formula (VIII-S) in a solution of the hydrocarbon solvent is added to the compound of formula (VII-S) in a solution of the ether solvent.

18. A process as in claim **12**, further comprising

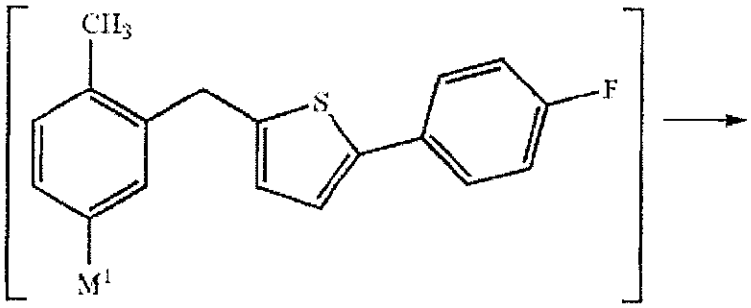


(V-S)

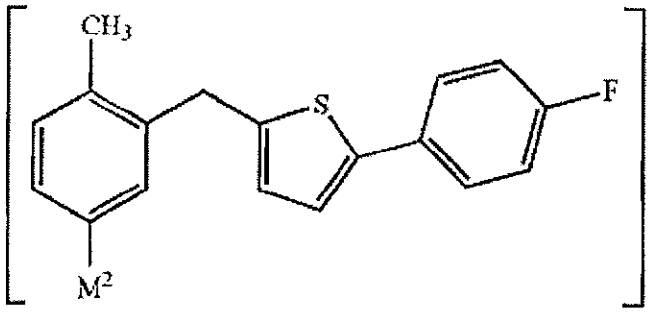


(VI-S)

reacting a compound of formula (V-S), wherein LG^1 is a leaving group; with an organo-lithium reagent; in a mixture of an ether solvent and a hydrocarbon solvent; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; to yield the corresponding compound of formula (VI-S), wherein M^1 is lithium;



(VI-S)



(VII-S)

reacting the compound of formula (VI-S) with a zinc salt or an amine complex of zinc halide; in a mixture of an ether solvent and a hydrocarbon solvent; wherein the ether solvent is selected from the group consisting of di-n-butyl ether and cyclopentylmethyl ether; to yield the corresponding compound of formula (VII-S).

19. A process as in claim **18**, wherein the organo-lithium reagent is n-hexyl lithium.

20. A process as in claim **18**, wherein the organo-lithium reagent is present in an amount in the range of from about 0.5 to about 2.0 molar equivalents.

21. A process as in claim **20**, wherein the organo-lithium reagent is present in an amount in the range of from about 1.0 to about 1.2 molar equivalents.

22. A process as in claim **18**, wherein the hydrocarbon solvent is toluene.

23. A process as in claim **18**, wherein the compound of formula (V-S) is reacted with the organo-lithium reagent at a temperature in the range of from about –78° C. to about room temperature.

24. A process as in claim **18**, wherein the zinc salt is selected from the group consisting of zinc dibromide ($ZnBr_2$), zinc diiodide (ZnI_2) and zinc ditriflate; and wherein the amine complex of zinc halide is selected from the group consisting of pyridine zinc bromide complex and N-methylmorpholine zinc bromide complex.

25. A process as in claim **18**, wherein the compound of formula (VI-S) is reacted with a zinc salt; and wherein the zinc salt is zinc dibromide.

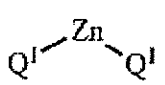
26. A process as in claim **25**, wherein the zinc dibromide is present in an amount in the range of from about 0.33 to about 1.0 molar equivalents.

27. A process as in claim **26**, wherein the zinc dibromide is present in an amount of about 0.5 molar equivalents.

28. A process as in claim **18**, wherein the compound of formula (VI-S) is reacted with a zinc salt in the presence of an amine or lithium salt.

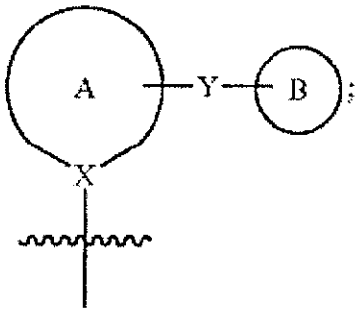
29. A process as in claim **28**, wherein the amine or lithium salt is selected from the group consisting of lithium bromide, lithium iodide, pyridine, N-methyl morpholine, 2,6-lutidine and TMEDA.

30. A process for the preparation of a compound of formula (X-P)



(X-P)

wherein both Q^1 groups are the same and are



and wherein Ring A and Ring B are one of the following:

(1) Ring A is an optionally substituted unsaturated monocyclic heterocyclic ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, an optionally substituted unsaturated fused heterobicyclic ring, or an optionally substituted benzene ring; or

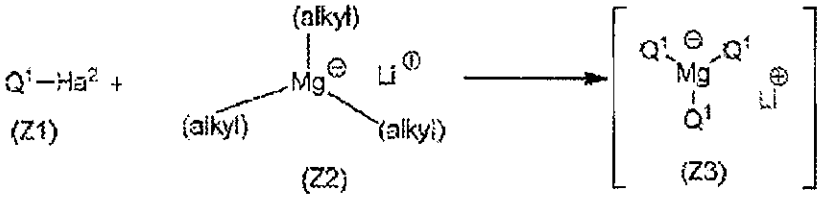
(2) Ring A is an optionally substituted benzene ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, or an optionally substituted unsaturated fused heterobicyclic ring wherein Y is linked to the heterocyclic ring of the fused heterobicyclic ring; or

(3) Ring A is an optionally substituted unsaturated fused heterobicyclic ring, wherein the sugar moiety X-(sugar) and the moiety —Y-(Ring B) are both on the same heterocyclic ring of the fused heterobicyclic ring, and Ring B is an optionally substituted unsaturated monocyclic heterocyclic ring, an optionally substituted unsaturated fused heterobicyclic ring, or an optionally substituted benzene ring;

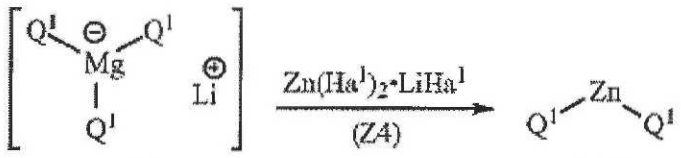
X is a carbon atom;

Y is $—(CH_2)_n—$; wherein n is 1 or 2;

provided that in Ring A, X is part of an unsaturated bond;



reacting a compound of the formula (Z1), wherein Ha^2 is a halogen, with a lithium trialkyl magnesate, a compound of formula (Z2); in a suitably selected anhydrous organic solvent or mixture or anhydrous organic solvents; to yield the corresponding compound of formula (Z3):

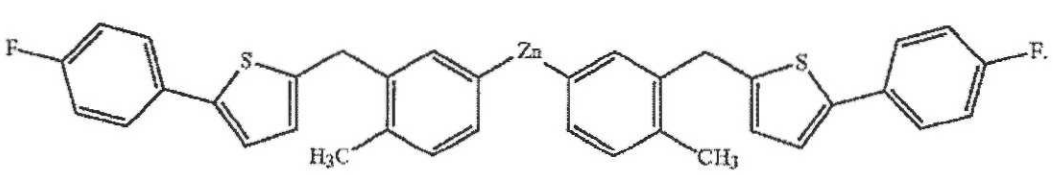


(Z3) (X-P)

reacting the compound of formula (Z3) with a zinc halide•lithium halide complex, a compound of formula (Z4), wherein Ha^1 is a halogen; in a suitably selected anhydrous organic solvent or mixture or anhydrous organic solvents; to yield the corresponding compound of formula (X-P).

31. A process as in claim **30**, wherein the compound of formula (Z2) is lithium dibutyl hexylmagnesate; and wherein the compound of formula (Z4) is zinc bromide•lithium bromide complex.

32. A process as in claim **30**, wherein the compound of formula (X-P) is a compound of formula (X-S)



(X-S)

33. A process as in claim **1**, wherein the hydrocarbon solvent is selected from the group consisting of toluene, fluorobenzene, cholorbenzene and benzotrifluoride.

34. A process as in claim **12**, wherein the hydrocarbon solvent is selected from the group consisting of toluene, fluorobenzene, chlorobenzene and benzotrifluoride.

35. A process as in claim **29**, wherein the amine or lithium salt is present in an amount in the range of from about 1.0 to about 2.0 molar equivalent.