CLAIMS

What is claimed is:

1. An α-diimine metal complex comprising a metal salt complexed to a bidentate or tridentate α-diimine compound wherein the α-diimine compound comprises an α-diimine group, a first imine nitrogen group, and a second imine nitrogen group which is different from the first imine nitrogen group.

2. The α-diimine metal complex of claim 1, wherein the α-diimine compound is tridentate, the α-diimine group is derived from an α-diacyl compound, the first imine nitrogen group consists of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group, and the second imine nitrogen group comprises a metal salt complexing group and a linking group linking the metal salt complexing group to the imine nitrogen group.

3. The α-diimine metal complex of claim 2, wherein the α-diimine group is derived from an aromatic α-diacyl compound.

4. The α-diimine metal complex of claim 3, wherein the α-diimine group is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone.

5. The α-diimine metal complex of claim 4, wherein the α-diimine group is derived from acenaphthenequinone.

6. The α-diimine metal complex of claim 1, wherein the first imine nitrogen group consists of a C_1 to C_{30} hydrocarbyl group.

7. The α-diimine metal complex of claim 6, wherein the first imine nitrogen group consists of a C_6 to C_{30} aromatic hydrocarbyl group.

8. The α-diimine metal complex of claim 7, wherein the C_6 to C_{30} aromatic hydrocarbyl group is a 2,6-dimethylphenyl group, a 2,6-diethylphenyl group, or a 2,6-diisopropylphenyl group.

9. The α-diimine metal complex of claim 2, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a

morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

10. The α-diimine metal complex of claim 9, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a substituted diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, or a substituted diphenyl phosphinyl group.

11. The α-diimine metal complex of claim 9, wherein the metal salt complexing group of the second imine nitrogen group comprises a 2-pyridinyl group or a substituted 2-pyridinyl group.

12. The α-diimine metal complex of claim 9, wherein the metal salt complexing group of the second imine nitrogen group comprises an alkyl etheryl group, a phenyl etheryl group, a substituted phenyl etheryl group, a alkyl sulfidyl group, a phenyl sulfidyl group, or a substituted sulfidyl group.

13. The α-diimine metal complex of claim 2, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

14. The α-diimine metal complex of claim 13, wherein the metal salt comprises iron.

15. The α-diimine metal complex of claim 1, wherein the α-diimine compound is bidentate, the α-diimine group is derived from an α-diacyl compound, the first imine nitrogen group consists of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group, the second imine nitrogen group consists of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group.

16. The α-diimine metal complex of claim 15, wherein the α-diimine group is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone.

17. The α-diimine metal complex of claim 15, wherein the first imine nitrogen group consists of an C_6 to C_{30} aromatic hydrocarbyl group and the second imine nitrogen group consists of an C_6 to C_{30} aromatic hydrocarbyl group.

18. An α-diimine metal complex comprising a metal salt comprising iron complexed to a tridentate α-diimine compound comprising:

1) an α-diimine group derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone;

2) a first imine nitrogen group consisting of a 2,6-dimethylphenyl group, a 2,6-diethylphenyl group, or a 2,6-diisopropylphenyl group; and

3) a second imine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the second imine nitrogen atom.

19. The α-diimine metal complex of claim 18, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a substituted diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, or a substituted diphenyl phosphinyl group and a linking group of the second imine nitrogen group is $-(CH_2)_m-$ where m is 2 or 3.

20. The α-diimine metal complex of claim 18, wherein the metal salt complexing group of the second imine nitrogen group comprises a 2-pyridinyl group or a substituted 2-pyridinyl group and the linking group of the second imine nitrogen group is $-(CH_2)-$.

21. The α-diimine metal complex of claim 18, wherein the metal salt complexing group of the second imine nitrogen group comprises a phenyl sulfidyl group or a substituted phenyl sulfidyl group and the linking group of the second imine nitrogen group is $-(CH_2CH_2)-$.

22. A method for producing an α-diimine metal complex comprising a metal salt complexed to a bidentate or tridentate α-diimine compound wherein the α-diimine compound comprises an α-diimine group, a first imine nitrogen group, and a second imine nitrogen group which is different from the first imine nitrogen group, the method comprising

forming at least one imine bond in the presence of a metal salt, metal complex, or combinations thereof.

23. The method of claim 22, wherein the method comprises:

a) contacting an α-acylimine compound, a metal salt, and a primary amine; and

b) recovering the α-diimine metal complex.

24. The method of claim 23, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine comprises an $-NH_2$ group, a metal salt complexing group and a linking group linking the metal salt complexing group to the $-NH_2$ group.

25. The method of claim 24, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

26. The method of claim 24, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from an aromatic α-dione and the α-acylimine nitrogen group of the α-acylimine compound consists of a C_1 to C_{30} hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

27. The method of claim 24, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone and the α-acylimine nitrogen group of the α-acylimine compound consists of a C_6 to C_{30} aromatic hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a pyridinyl group, or a morphilinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-5.

28. The method of claim 24, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from acenaphthenequinone and the α-acylimine nitrogen group of the α-acylimine compound consists of a 2,6-disubstituted phenyl group; and 2) the metal salt complexing group of the primary amine comprises a diphenyl aminyl group, a substituted diphenyl aminyl group, a diphenyl phosphinyl group, a substituted diphenyl phosphinyl group, a phenyl sulfidyl group, a substituted phenyl sulfidyl group, a pyridinyl group, or a substituted pyridinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-3.

29. The method of claim 23, wherein the α-acylimine compound is prepared by:
    a) contacting an α-diacyl compound and a primary amine consisting of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group; and
    b) recovering the α-acylimine compound.

30. The method of claim 23, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group consisting of an of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine consists of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

31. The method of claim 23, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the α-acylimine nitrogen atom; and 2) the primary amine consists of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

32. The method of claim 22, wherein the method comprises:
a) contacting an α-acylimine metal complex and a primary amine; and
b) recovering the α-diimine metal complex.

33. The method of claim 32, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine comprises a $-NH_2$ group, a metal salt complexing group, and a linking group linking the metal salt complexing group to the $-NH_2$ group.

34. The method of claim 33, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

35. The method of claim 33, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from an aromatic α-dione and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a C_1 to C_{30} hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

36. The method of claim 33, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a C_6 to C_{30} aromatic hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a pyridinyl group, or a morphilinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-5.

37. The method of claim 33, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from acenaphthenequinone and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a 2,6-disubstituted phenyl group; and 2) the metal salt complexing group of the primary amine comprises a diphenyl aminyl group, a substituted diphenyl aminyl group, a diphenyl phosphinyl group, a substituted diphenyl phosphinyl group, a phenyl sulfidyl group, a substituted phenyl sulfidyl group, a pyridinyl group, or a substituted pyridinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-3.

38. The method of claim 33, wherein the α-acylimine metal complex is prepared by:
    a) contacting an α-diacyl compound and a primary amine consisting of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group;
    b) recovering the α-acylimine compound;
    c) contacting the α-acylimine compound with a metal salt; and
    d) recovering the α-acylimine metal complex.

39. The method of claim 33, wherein the α-acylimine metal complex is prepared by:
    a) contacting an α-diacyl compound, a metal salt, and a primary amine consisting of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group; and
    b) recovering the α-acylimine metal complex.

40. The method of claim 32, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional

groups or a hydrocarbyl group; and 2) the primary amine consists of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

41. The method of claim 32, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the α-acylimine nitrogen atom; and 2) a primary amine consisting of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

CLAIMS

What is claimed is:

1. An α-diimine metal complex comprising a metal salt complexed to a tridentate α-diimine compound wherein the α-diimine compound comprises an α-diimine group derived from an α-diacyl compound, a first imine nitrogen group consisting of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group, and a second imine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the imine nitrogen group.

2. The α-diimine metal complex of claim 1, wherein the α-diimine group is derived from an aromatic α-diacyl compound.

3. The α-diimine metal complex of claim 2, wherein the α-diimine group is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone.

4. The α-diimine metal complex of claim 3, wherein the α-diimine group is derived from acenaphthenequinone.

5. The α-diimine metal complex of claim 1, wherein the first imine nitrogen group consists of a C_1 to C_{30} hydrocarbyl group.

6. The α-diimine metal complex of claim 5, wherein the first imine nitrogen group consists of a C_6 to C_{30} aromatic hydrocarbyl group.

7. The α-diimine metal complex of claim 6, wherein the C_6 to C_{30} aromatic hydrocarbyl group is a 2,6-dimethylphenyl group, a 2,6-diethylphenyl group, or a 2,6-diisopropylphenyl group.

8. The α-diimine metal complex of claim 1, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

9. The α-diimine metal complex of claim 8, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a substituted diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, or a substituted diphenyl phosphinyl group.

10. The α-diimine metal complex of claim 8, wherein the metal salt complexing group of the second imine nitrogen group comprises a 2-pyridinyl group or a substituted 2-pyridinyl group.

11. The α-diimine metal complex of claim 8, wherein the metal salt complexing group of the second imine nitrogen group comprises an alkyl etheryl group, a phenyl etheryl group, a substituted phenyl etheryl group, a alkyl sulfidyl group, a phenyl sulfidyl group, or a substituted sulfidyl group.

12. The α-diimine metal complex of claim 1, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

13. The α-diimine metal complex of claim 12, wherein the metal salt comprises iron.

14. The α-diimine metal complex of claim 1, wherein the α-diimine compound is bidentate, the α-diimine group is derived from an α-diacyl compound, the first imine nitrogen group consists of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group, the second imine nitrogen group consists of a C_1 to C_{30} organyl group consisting of inert functional groups or a C_1 to C_{30} hydrocarbyl group.

15. The α-diimine metal complex of claim 14, wherein the α-diimine group is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone.

16. The α-diimine metal complex of claim 14, wherein the first imine nitrogen group consists of an C_6 to C_{30} aromatic hydrocarbyl group and the second imine nitrogen group consists of an C_6 to C_{30} aromatic hydrocarbyl group.

17. An α-diimine metal complex comprising a metal salt comprising iron complexed to a tridentate α-diimine compound comprising:

    1) an α-diimine group derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone;

2) a first imine nitrogen group consisting of a 2,6-dimethylphenyl group, a 2,6-diethylphenyl group, or a 2,6-diisopropylphenyl group; and

3) a second imine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the second imine nitrogen atom.

18. The α-diimine metal complex of claim 17, wherein the metal salt complexing group of the second imine nitrogen group comprises a dialkyl aminyl group, a diphenyl aminyl group, a substituted diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, or a substituted diphenyl phosphinyl group and a linking group of the second imine nitrogen group is $-(CH_2)_m-$ where m is 2 or 3.

19. The α-diimine metal complex of claim 17, wherein the metal salt complexing group of the second imine nitrogen group comprises a 2-pyridinyl group or a substituted 2-pyridinyl group and the linking group of the second imine nitrogen group is $-(CH_2)-$.

20. The α-diimine metal complex of claim 17, wherein the metal salt complexing group of the second imine nitrogen group comprises a phenyl sulfidyl group or a substituted phenyl sulfidyl group and the linking group of the second imine nitrogen group is $-(CH_2CH_2)-$.

21. A method for producing an α-diimine metal complex comprising a metal salt complexed to a bidentate or tridentate α-diimine compound wherein the α-diimine compound comprises an α-diimine group, a first imine nitrogen group, and a second imine nitrogen group which is different from the first imine nitrogen group, the method comprising

forming at least one imine bond in the presence of a metal salt, metal complex, or combinations thereof.

22. The method of claim 21, wherein the method comprises:

a) contacting an α-acylimine compound, a metal salt, and a primary amine; and

b) recovering the α-diimine metal complex.

23. The method of claim 22, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine comprises an $-NH_2$

group, a metal salt complexing group and a linking group linking the metal salt complexing group to the -NH_2 group.

24. The method of claim 23, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

25. The method of claim 23, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from an aromatic α-dione and the α-acylimine nitrogen group of the α-acylimine compound consists of a C_1 to C_{30} hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

26. The method of claim 23, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone and the α-acylimine nitrogen group of the α-acylimine compound consists of a C_6 to C_{30} aromatic hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a pyridinyl group, or a morphilinyl group, and the linking group of the primary amine is -$(CH_2)_m$- where m ranges from 1-5.

27. The method of claim 23, wherein the 1) the α-acylimine group of the α-acylimine compound is derived from acenaphthenequinone and the α-acylimine nitrogen group of the α-acylimine compound consists of a 2,6-disubstituted phenyl group; and 2) the metal salt complexing group of the primary amine comprises a diphenyl aminyl group, a substituted diphenyl aminyl group, a diphenyl phosphinyl group, a substituted diphenyl phosphinyl group, a phenyl sulfidyl group, a substituted phenyl sulfidyl group, a pyridinyl group, or a substituted pyridinyl group, and the linking group of the primary amine is -$(CH_2)_m$- where m ranges from 1-3.

28. The method of claim 22, wherein the α-acylimine compound is prepared by:

a) contacting an α-diacyl compound and a primary amine consisting of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group; and

b) recovering the α-acylimine compound.

29. The method of claim 22, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group consisting of an of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine consists of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

30. The method of claim 22, wherein: 1) the α-acylimine compound comprises an α-acylimine group and an α-acylimine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the α-acylimine nitrogen atom; and 2) the primary amine consists of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

31. The method of claim 21, wherein the method comprises:

a) contacting an α-acylimine metal complex and a primary amine; and

b) recovering the α-diimine metal complex.

32. The method of claim 31, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine comprises a –NH_2 group, a metal salt complexing group, and a linking group linking the metal salt complexing group to the –NH_2 group.

33. The method of claim 32, wherein the metal salt comprises chromium, iron, cobalt, or mixtures thereof.

34. The method of claim 32, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from an aromatic α-dione and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a C_1 to C_{30} hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl

group, a phenyl sulfidyl group, a furanyl group, a thiophenyl group, a tetrahydrofuranyl group, a thiophanyl group, a pyridinyl group, a morphilinyl group, a pyranyl group, a tetrahydropyranyl group, a quinolinyl group, a pyrrolyl group, a pyrrolidinyl group, or a piperidinyl group and the linking group of the primary amine comprises a C_1 to C_{10} hydrocarbyl group.

35. The method of claim 32, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from acenaphthenequinone, phenanthrenequinone, or pyrenequinone and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a C_6 to C_{30} aromatic hydrocarbyl group; and 2) the metal salt complexing group of the primary amine comprises a dialkyl aminyl group, a diphenyl aminyl group, a dialkyl phosphinyl group, a diphenyl phosphinyl group, an alkyl etheryl group, a phenyl etheryl group, an alkyl sulfidyl group, a phenyl sulfidyl group, a pyridinyl group, or a morphilinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-5.

36. The method of claim 32, wherein the 1) the α-acylimine group of the α-acylimine compound in the α-acylimine metal complex is derived from acenaphthenequinone and the α-acylimine nitrogen group of the α-acylimine compound in the α-acylimine metal complex consists of a 2,6-disubstituted phenyl group; and 2) the metal salt complexing group of the primary amine comprises a diphenyl aminyl group, a substituted diphenyl aminyl group, a diphenyl phosphinyl group, a substituted diphenyl phosphinyl group, a phenyl sulfidyl group, a substituted phenyl sulfidyl group, a pyridinyl group, or a substituted pyridinyl group, and the linking group of the primary amine is $-(CH_2)_m-$ where m ranges from 1-3.

37. The method of claim 32, wherein the α-acylimine metal complex is prepared by:

a) contacting an α-diacyl compound and a primary amine consisting of an $-NH_2$ group and an organyl group consisting of inert functional groups or a hydrocarbyl group;

b) recovering the α-acylimine compound;

c) contacting the α-acylimine compound with a metal salt; and

d) recovering the α-acylimine metal complex.

38. The method of claim 32, wherein the α-acylimine metal complex is prepared by:

a) contacting an α-diacyl compound, a metal salt, and a primary amine consisting of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group; and

b) recovering the α-acylimine metal complex.

39. The method of claim 31, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group consisting of an organyl group consisting of inert functional groups or a hydrocarbyl group; and 2) the primary amine consists of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group.

40. The method of claim 31, wherein: 1) the α-acylimine metal complex comprises a complex between a metal salt and an α-acylimine compound comprising an α-acylimine group and an α-acylimine nitrogen group comprising a metal salt complexing group and a linking group linking the metal salt complexing group to the α-acylimine nitrogen atom; and 2) a primary amine consisting of an -NH_2 group and an organyl group consisting of inert functional groups or a hydrocarbyl group.