WHAT IS CLAIMED IS:

1. A method of preparing a solid pre-catalyst system comprising:

in a reactor under agitation with a stirring mechanism, reacting a colloidal suspension of an organic solvent and a complex of Formula I with a halogenated compound or a mixture of halogenated compounds at a starting reactor temperature;

allowing the colloidal suspension to exothermically react under a controlled feed rate to form a precipitate, which is then allowed to reach an upper temperature limit for a sufficient period of time to form a reacted colloidal suspension; and

allowing the reacted colloidal suspension to cool to completion temperature;

wherein:

the complex of Formula I is:

$$XTiCl_p(OR^1)_{4-p} \cdot YMg(OR^2)_q(OR^3)_t \qquad (I)$$

a molar ratio of X to Y (X/Y) is from 0.2 to 5.0;

p is 0 or 1;

$0 < q < 2$;

$0 < t < 2$;

the sum of q and t is 2;

R^1, R^2, and R^3 are each independently a linear or branched alkyl, a linear or branched heteroalkyl, a cycloalkyl, a substituted cycloalkyl, a substituted heterocycloalkyl, a substituted aryl, or a (heteroaryl)alkyl;

R^2 is not the same as R^3; and

the precipitate exhibits a D_{50} from 3 μm to 10 μm.

2. The method of Claim 1, wherein the complex of Formula I exhibits a Fourier Transform Infrared C-H stretching vibration bands at wavenumber from 2500 cm^{-1} to 5000 cm^{-1}.

3. The method of Claim 1, wherein the starting reactor temperature is -10ºC to 60ºC.

4. The method of Claim 1-3, wherein the upper temperature limit is less than 70ºC.

5. The method of Claim 4, wherein the upper temperature limit is 60ºC.

6. The method of any one of Claims 1-5, wherein the completion temperature is 35ºC to 60ºC.

7. The method of any one of Claims 1-6, wherein the agitating comprises stirring the reacted colloidal suspension at 400 rpm to 2000 rpm.

8. The method of any one of Claims 1-7 further comprising collecting the precipitate and washing the precipitate with an organic solvent or a mixture of organic solvents.

9. The method of any one of Claims 1-8, wherein the D_{50} is from 3 μm to 12 μm.

10. The method of any one of Claims 1-9, wherein the halogenated compound or a mixture of halogenated compounds comprises diethyl aluminum chloride (DEAC), ethylaluminum sesquichloride (EASC), ethyl aluminum dichloride (EADC), titanium tetrachloride ($TiCl_4$), silicon tetrachloride ($SiCl_4$) or a mixture of any two or more thereof.

11. The method of any one of Claims 1-10, wherein the organic solvent comprises an alkane, an aromatic, or a mixture of any two or more thereof.

12. The method of Claim 11, wherein organic solvent comprises n-hexane, n-pentane, cyclohexane, toluene, benzene, benzine, o-cresol, p-cresol, m-cresol, 1,2-dimethylbenzene, 1,3-dimethylbenzene, 1,4-dimethylbenzene, ethylbenzene, cumine, trichloroethylene, trichlorobenzene, o-dichlorobenzene, or a mixture of any two or more thereof.

13. The method of Claim 12, wherein organic solvent comprises n-hexane.

14. The method of any one of Claims 1-13, wherein the reacting comprises charging the reactor with a first portion of the solvent and the halogenated compound or a mixture of halogenated compounds, and adding the complex of Formula I in a second portion of the solvent to the reactor at a first feed rate.

15. The method of Claim 14, wherein the feed rate is from 0.05 mL/min to 4 mL/min.

16. The method of Claim 14 or 15, wherein the reaction temperature is -10ºC to 60ºC, the upper temperature limit is 60ºC and the sufficient time is 1 hour.

17. The method of any one of Claims 1-13, wherein the reacting comprises charging the reactor with a first portion of the solvent and the complex of Formula I, and adding the halogenated compound or a mixture of halogenated compounds in a second portion of the solvent to the reactor at a first feed rate.

18. The method of Claim 17, wherein the first feed rate is from 0.05 mL/min to 4.0 mL/min.

19. The method of Claim 17 or 18, wherein the starting temperature is from -10ºC, the upper temperature limit is 60ºC, and the sufficient time is 1 hour, and the completion temperature is 40ºC.

20. The method of any one of Claims 1-13, wherein the reacting comprises charging the reactor with a first portion of the solvent, and, simultaneously charging the reactor with the complex of Formula I in a second portion of the solvent at a first feed rate and the halogenated compound or a mixture of halogenated compounds in a third portion of the solvent at a second feed rate.

21. The method of Claim 20, wherein the first feed rate and the second feed rate are from 0.05 L/min to 2.5 L/min.

22. The method of Claim 17 or 18, wherein the starting temperature is from -10ºC, the upper temperature limit is 60ºC, and the sufficient time is 1 hour, and the completion temperature is 40ºC.

23. The method of Claims14-21, wherein the parameters of turbidity of the reaction medium k_T ranges from 1.5 to 4.0 h^{-1} and the maximum turbidity unity (TU_{max}) relative to image analysis range from 0.4 to 1.0 TU.

24. A solid pre-catalyst system comprising solid particles of a reaction product of a complex of Formula I with a halogenated compound or a mixture of halogenated compounds;
wherein:

$$XTiCl_p(OR^1)_{4-p} \cdot YMg(OR^2)_q(OR^3)_t \qquad (I)$$

a molar ratio of X to Y (X/Y) is from 0.2 to 5.0;

p is 0 or 1;

$0 < q < 2$;

$0 < t < 2$;

the sum of q and t is 2;

R^1, R^2, and R^3 are each independently a linear or branched alkyl, a linear or branched heteroalkyl, a cycloalkyl, a substituted cycloalkyl, a substituted heterocycloalkyl, a substituted aryl, or a (heteroaryl)alkyl;

R^2 is not the same as R^3; and

the solid particles exhibit a D_{50} from 3 μm to 12 μm.

25. The solid pre-catalyst system of claim 24, wherein the halogenated compound comprises diethyl aluminum chloride (DEAC), ethylaluminum sesquichloride (EASC), ethyl aluminum dichloride (EADC), titanium tetrachloride ($TiCl_4$), silicon tetrachloride ($SiCl_4$) or a mixture of any two or more thereof.

26. The solid pre-catalyst system of claims 24 or 25, wherein the pre-catalyst system is further contacting with a reducing agent.

27. A method of polymerizing or co-polymerizing an olefin monomer, the method comprising:

contacting a solid pre-catalyst system comprising solid particles of a composite of a reaction product of a halogenated compound and a colloidal suspension of a complex of Formula I with a reducing agent, optionally a chain transfer agent, and the olefin monomer or monomers:

$$XTiCl_p(OR^1)_{4-p} \cdot YMg(OR^2)_q(OR^3)_t \qquad (I)$$

wherein:

a molar ratio of X to Y (X/Y) is from 0.2 to 5.0;

p is 0 or 1;

$0 < q < 2$;

$0 < t < 2$;

the sum of q and t is 2;

R^1, R^2, and R^3 are each independently a linear or branched alkyl, a linear or branched heteroalkyl, a cycloalkyl, a substituted cycloalkyl, a substituted heterocycloalkyl, a substituted aryl, or a (heteroaryl)alkyl;

R^2 is not the same as R^3; and

the solid particles exhibit a D_{50} from 3 μm to 12 μm.

28. The method of claim 27, wherein the reducing agent comprises diethyl aluminum chloride (DEAC), triethyl aluminum (TEA), ethylaluminum sesquichloride (EASC), ethyl aluminum dichloride (EADC), triisobutyl aluminum (TiBA), trimethyl aluminum (TMA), methylaluminoxane (MAO), or a mixture of any two or more thereof.

29. The method of claim 27, wherein the olefin monomer comprises ethylene, propylene, 1-butene, 4-methyl-1-pentene, 1-hexene, 1-octene, or a mixture of any two or more thereof.

30. The method of claim 27, wherein the chain transfer agent is hydrogen.

31. The method of any one of claims 27-30, wherein the solid catalyst system exhibits a catalyst efficiency (CE) of greater than 6 kg/g.hr.

32. The method of any one of claims 27-30, wherein the olefin is ethylene, and the method further comprises collecting polyethylene exihibiting number average molar mass (M_n) between 10-250 kg/mol.

33. The method of any one of claims 27-30, wherein the olefin is ethylene, and the method further comprises collecting polyethylene exihibiting weight average molar mass (M_w) between 150-1250 kg/mol.

34. The method of any one of claims 27-30, wherein the olefin is ethylene, and the method further comprises collecting polyethylene exihibiting polydispersity (M_w/M_n) between 3 and 8.

35. The method of any one of claims 27-30, wherein the olefin is ethylene, and the method further comprises collecting polyethylene, which less than 5 wt% of the polymer is

eluted with 1,2-dichlorobenzene below 30°C by crystallization elution fractionation (CEF) analysis.

36. The method of any one of claims 27-30, wherein the olefin is ethylene, and the method further comprises collecting polyethylene, which more than 90 wt% of the polymer is eluted with 1,2-dichlorobenzene at temperature higher than 85 °C by crystallization elution fractionation (CEF) analysis.

37. A complex of Formula I:

$$XTiCl_p(OR^1)_{4-p} \cdot YMg(OR^2)_q(OR^3)_t \qquad (I)$$

wherein:

a molar ratio of X to Y (X/Y) is from 0.2 to 5.0;

p is 0 or 1;

$0 < q < 2$;

$0 < t < 2$;

the sum of q and t is 2;

R^1, R^2, and R^3 are each independently a linear or branched alkyl, a linear or branched heteroalkyl, a cycloalkyl, a substituted cycloalkyl, a substituted heterocycloalkyl, a substituted aryl, or a (heteroaryl)alkyl; and

R^2 is not the same as R^3.