a) forming a reaction mixture comprising (i) a metal salt, and (ii) a reaction medium comprising a capping agent, and

b) subjecting the reaction mixture to heat conditions to enable the formation of elemental metal, thereby forming said metal-containing particles.

In a first aspect, there is provided a process for producing transition metal-containing particles, the process comprising:

a) forming a reaction mixture comprising (i) a transition metal salt, and (ii) a reaction medium comprising a capping agent,

b) subjecting the reaction mixture to heat conditions to enable the formation of elemental transition metal, thereby forming the transition metal-containing particles, and

c) recycling the reaction medium for reuse in step (a).

Advantageously, the capping agent may also function as a reducing agent. Therefore, the disclosed process may not require the use of other reducing agent(s) such as strong reducing agents, glucose or ascorbic acid. Known reducing agents may be expensive and/or toxic. Therefore, the disclosed process may advantageously be efficient, cost-effective, non-toxic and environmentally friendly.

Also advantageously, the capping agent may also function as a surface-protecting agent. Therefore, the disclosed process may also not require surface-protecting agents which may also be expensive and/or toxic. Therefore, the disclosed process may be efficient, cost-effective, non-toxic and environmentally friendly.

Further advantageously, the reaction medium of the disclosed process may be reused. The reusability of the

comprising:

a) forming a reaction mixture comprising (i) a transition metal salt, and (ii) a reaction medium comprising a capping agent,

b) subjecting the reaction mixture to heat conditions to enable the formation of elemental transition metal, thereby forming transition metal-containing particles,

c) recycling the reaction medium for reuse in step (a), and

d) adding the transition metal-containing particles produced by the process of steps (a) to (c) to a heat transfer medium.

Advantageously, the thermally conductive composition possesses enhanced thermal conductivity when compared to a composition without the disclosed metal-containing particles.

In a third aspect, there is provided a thermally conductive composition comprising a heat transfer medium and a transition metal-containing particle produced by a process as defined above.

Advantageously, the thermal conductivity of the thermally conductive composition may be greatly enhanced when doped with the disclosed metal-containing particles.

Definitions

The following words and terms used herein shall have the meaning indicated.

As used herein, the term "metal-containing particles" include, but are not limited to, elemental metal particles, metal particle-based composites, fine particles comprising metal, metal microparticles, metal microwires, metal microrods, metal nanoparticles, metal nanowires, metal nanorods, transition metal particles,

Claims

1. A process for producing transition metal-containing particles, the process comprising:
   a) forming a reaction mixture comprising (i) a transition metal salt, and (ii) a reaction medium comprising a capping agent,
   b) subjecting the reaction mixture to heat conditions to enable the formation of elemental transition metal, thereby forming the transition metal-containing particles, and
   c) recycling the reaction medium for reuse in step (a).

2. The process according to claim 1, wherein the capping agent also functions as a reducing agent.

3. The process according to claim 2, wherein the reaction mixture excludes other reducing agent(s).

4. The process according to any one of claims 1 to 3, further comprising the step of eliminating oxygen from the reaction medium prior to step a).

5. The process according to any one of claims 1 to 4, further comprising:

   (d) forming a reaction mixture comprising a transition metal salt and the recycled reaction medium of step c); and
   (e) subjecting the reaction mixture of step d) to heat conditions to enable the formation of elemental transition metal, thereby forming transition metal-containing particles.

12. The process according to any one of claims 1 to 10, wherein the amine is selected from the group consisting of dodecylamine, tetradecylamine, hexadecylamine, octadecylamine, oleylamine, and mixtures thereof.

13. The process according to any one of claims 1 to 12, wherein the transition metal salt is a salt of a transition metal with +1 oxidation state.

14. The process according to claim 13, wherein the transition metal is selected from the group consisting of Cu(I), Ag(I), Au(I) and Hg(I).

15. The process according to any one of claims 1 to 12, wherein the transition metal salt is a salt of a transition metal with +2 oxidation state.

16. The process according to claim 15, wherein the transition metal is selected from the group consisting of Sn(II), Ga(II), Fe(II) and Co(II).

17. The process according to any one of claims 1 to 16, wherein the anion of the transition metal salt is selected from the group consisting of nitrate, sulfate, hydroxide, acetate,trifluoroacetate, carbonate and acetylacetonate.

18. The process according to any one of claims 1 to 17, wherein the transition metal-containing particles have nano- or micro-scale dimensions.

19. The process according to any one of claims 1 to 18, wherein a yield of more than 30% transition metal-containing particles is obtained.

20. The process according to any one of claims 1 to 19, further comprising the step of coordinating at least part of the surface of the transition metal salt to the capping agent.

21. The process according to any one of claims 1 to 20, further comprising the step of agitating the reaction mixture.

22. A process for producing a thermally conductive composition, the process comprising:

a) forming a reaction mixture comprising (i) a transition metal salt, and (ii) a reaction medium comprising a capping agent,

b) subjecting the reaction mixture to heat conditions to enable the formation of elemental transition metal, thereby forming transition metal-containing particles,

c) recycling the reaction medium for reuse in step (a), and

d) adding the transition metal-containing particles produced by the process of steps (a) to (c) to a heat transfer medium.

23. The process according to claim 22, wherein the heat transfer medium is a phase change material.

24. The process according to claim 23, wherein the phase change material is selected from the group consisting of sodium sulfate, magnesium sulfate, calcium chloride, magnesium chloride, potassium fluoride, potassium aluminum sulfate, calcium nitrate, magnesium nitrate, and hydrated salts thereof.

25. The process according to any one of claims 22 to 24, further comprising the step of selecting 0.02 wt% to 0.20 wt% transition metal-containing particles based on the thermally conductive composition.

26. A thermally conductive composition comprising a heat transfer medium and a transition metal-containing particle

produced by the process according to any one of claims 1 to 21.

27. The composition according to claim 26 wherein the heat transfer medium is a phase change material.

28. The composition according to claim 27, wherein the phase change material is selected from the group consisting of sodium sulfate, magnesium sulfate, calcium chloride, magnesium chloride, potassium fluoride, potassium aluminum sulfate, calcium nitrate, magnesium nitrate, and hydrated salts thereof.

29. The composition according to any one of claims 26 to 28, wherein said composition comprises 0.02 wt% to 0.20 wt% transition metal-containing particles based on the thermally conductive composition.