lubricants, a lubricant composition containing the nanoparticles and a method for reducing boundary friction using the nanoparticles. The nanoparticles are made by reacting an organo-cerium salt, a fatty acid, and an amine in the substantial absence of water at a temperature ranging from about 150° to about 250° C. for a period of time sufficient to provide nanoparticles while injecting air into the reaction mixture during a portion of the reaction period. The reaction product includes from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

[0006] In one aspect ~~another embodiment~~, there is provided a method for reducing a friction coefficient adjacent a lubricated surface~~.~~, ~~—~~comprising ~~The method includes~~ providing an amount of reaction product comprising metal-containing nanoparticles dispersed in a fully formulated lubricant composition containing a base oil of lubricating viscosity, and applying the lubricant composition containing the reaction product ~~metal-containing nanoparticles~~ to a surface to be lubricated, wherein~~.~~ ~~T~~the nanoparticles in the reaction product are self-dispersing and the ~~are a~~ reaction product is made by an improved process ~~of reaction mixture~~ of organo-cerium salt, fatty acid, and an amine in a reaction mixture ~~reacted~~ in the absence of solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises reacting the organo-cerium salt, a fatty acid, and an amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture and under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide ~~for a period of time sufficient to provide nanoparticles. T~~the reaction product ~~includes~~ comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

[0006a] In another aspect, there is provided a method for making a self-dispersing cerium oxide nanoparticles in the lubricants by an improved process of reacting a mixture of organo-cerium salt, fatty acid, and amine in the substantial absence of water and organic solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises providing a reaction mixture having a molar ratio of organo-cerium salt to amine to fatty acid ranging from about 1:1:1 to about 1:2:2 in the reaction mixture providing the reaction mixture under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide a reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

[0006b] In another aspect, there is provided a lubricant composition comprising up to about 5 weight percent of metal-containing nanoparticles made by the method as defined above.

[0006c] In another aspect, there is provided a lubricant composition comprising:

a base oil of lubricating viscosity; and

a boundary friction reducing amount of a reaction product comprising self-dispersing metal-containing nanoparticles dispersed in the base oil, wherein the reaction product is made by an improved process of reacting a mixture of organo-cerium salt, a fatty acid, and an amine reacted in the absence of solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises reacting the organo-cerium salt, a fatty acid, and an amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide the reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

[0007] Another embodiment of the disclosure provides a lubricant composition containing a base oil of lubricating viscosity and a boundary friction reducing amount of a reaction product containing metal-containing nanoparticles dispersed in the base oil. The nanoparticles are made by reacting an organo-cerium salt, a fatty acid, and an amine at a temperature ranging from about 150° to about 250° C. in the absence of solvent for a period of time sufficient to provide nanoparticles. The product of the reaction includes from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

[0008] As set forth briefly above, embodiments of the disclosure provide a unique nanoparticle additive for lubricants and finished lubricant compositions containing the nanoparticle additive that may significantly improve the coefficient of friction of the lubricant

~~What is claimed is:~~

1. A method for reducing a friction coefficient adjacent a lubricated surface, comprising providing an amount of reaction product comprising metal-containing nanoparticles dispersed in a fully formulated lubricant composition containing a base oil of lubricating viscosity, and applying the lubricant composition containing the reaction product to a surface to be lubricated, wherein the nanoparticles in the reaction product are self-dispersing and comprise a reaction product made by an improved process of reacting an organo-cerium salt, a fatty acid, and an amine in a reaction mixture in the absence of solvent at a temperature ranging from about 150° to about 250° C., the improvement comprising reacting the organo-cerium salt, fatty acid and amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture to provide the reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

2. The method of claim 1, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical nanoparticles, and plate shaped nanoparticles.

3. The method of claim 1, wherein reaction mixture is reacted under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon.

4. The method of claim 3, wherein the atmosphere comprises air and the air is delivered subsurface to the reaction mixture.

5. The method of claim 1, wherein the organo-cerium salt comprises cerium (III) acetate.

6. The method of claim 1, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

7. The method of claim 1, wherein the reaction mixture is substantially devoid of water.

8. The method of claim 1, wherein the amount of metal-containing nanoparticles in the fully formulated lubricant composition ranges up to about 5 percent by weight.

9. The method of claim 1, wherein the amount of metal-containing nanoparticles in the fully formulated lubricant composition ranges from about 0.1 to about 2 percent by weight.

10. A method for making a self-dispersing cerium oxide nanoparticles additive for lubricants by an improved process of reacting a mixture of organo-cerium salt, fatty acid, and amine in the substantial absence of water and organic solvent at a temperature ranging from about 150° to about 250° C., the improvement comprising providing a reaction mixture having a molar ratio of organo-cerium salt to amine to fatty acid ranging from about 1:1:1 to about 1:2:2 in the reaction mixture to provide a reaction product containing the nanoparticles comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

11. The method of claim 10, wherein the nanoparticles as made in the reaction product are self-dispersing in a lubricant composition.

12. The method of claim 10, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical nanoparticles, and plate shaped nanoparticles having a size ranging from about 1 to about 50 nanometers.

13. The method of claim 10, wherein the organo-cerium salt comprises cerium (III) acetate.

14. The method of claim 10, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

15. The method of claim 10, wherein the reaction mixture is substantially devoid of water.

~~16. The method of claim 10, wherein the improvement further comprises~~ injecting air into the mixture during a portion of the reaction period.

16. A lubricant composition comprising up to about 5 weight percent of metal-containing nanoparticles made by the method of claim 10.

17. A lubricant composition comprising:

a base oil of lubricating viscosity; and

a boundary friction reducing amount of a reaction product comprising self-dispersing metal-containing nanoparticles dispersed in the base oil, wherein the nanoparticles are made by an improved process of reacting a mixture of organo-cerium salt, a fatty acid, and an amine reacted in the absence of solvent at a temperature ranging from about 150° to about 250° C., the improvement comprising reacting the organo-cerium salt, fatty acid and amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture to provide the reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

18. The lubricant composition of claim 17, wherein the organo-cerium salt comprises cerium (III) acetate.

19. The lubricant composition of claim 17, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

20. The lubricant composition of claim 17, wherein the reaction mixture is substantially devoid of water.

21. The lubricant composition of claim 17, wherein the amount of metal-containing nanoparticles dispersed in the base oil ranges up to about 5 percent by weight.

22. The lubricant composition of claim 17, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical

~~nanoparticles, and plate shaped nanoparticles having a size ranging from about 1 to~~ about 50 nanometers.

23. The lubricant composition of claim 17, wherein the fatty acid comprises an unsaturated fatty acid containing from about 10 to about 26 carbon atoms.

24. The lubricant composition of claim 17, wherein the amine comprises an unsaturated hydrocarbyl amine containing from about 3 to about 24 carbon atoms.

What is claimed is:

1. A method for reducing a friction coefficient adjacent a lubricated surface, comprising providing an amount of reaction product comprising metal-containing nanoparticles dispersed in a fully formulated lubricant composition containing a base oil of lubricating viscosity, and applying the lubricant composition containing the reaction product to a surface to be lubricated, wherein the nanoparticles in the reaction product are self-dispersing and the reaction product is made by an improved process of reacting an organo-cerium salt, a fatty acid, and an amine in a reaction mixture in the absence of solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises reacting the organo-cerium salt, a fatty acid, and an amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture and under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide the reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

2. The method of claim 1, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical nanoparticles, and plate shaped nanoparticles.

3. The method of claim 1, wherein the atmosphere comprises air and the air is delivered subsurface to the reaction mixture.

4. The method of claim 1, wherein the organo-cerium salt comprises cerium (III) acetate.

5. The method of claim 1, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

6. The method of claim 1, wherein the reaction mixture is substantially devoid of water.

7. The method of claim 1, wherein the amount of metal-containing nanoparticles in the fully formulated lubricant composition ranges up to about 5 percent by weight.

8. The method of claim 1, wherein the amount of metal-containing nanoparticles in the fully formulated lubricant composition ranges from about 0.1 to about 2 percent by weight.

9. A method for making a self-dispersing cerium oxide nanoparticles additive for lubricants by an improved process of reacting a mixture of organo-cerium salt, fatty acid, and amine in the substantial absence of water and organic solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises providing a reaction mixture having a molar ratio of organo-cerium salt to amine to fatty acid ranging from about 1:1:1 to about 1:2:2 in the reaction mixture providing the reaction mixture under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide a reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

10. The method of claim 7, wherein the nanoparticles as made in the reaction product are self-dispersing in a lubricant composition.

11. The method of claim 7, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical nanoparticles, and plate shaped nanoparticles having a size ranging from about 1 to about 50 nanometers.

12. The method of claim 7, wherein the organo-cerium salt comprises cerium (III) acetate.

13. The method of claim 7, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

14. The method of claim 7, wherein the reaction mixture is substantially devoid of water.

15. The method of claim 9, wherein the improvement further comprises injecting air into the mixture during a portion of the reaction period.

16. A lubricant composition comprising up to about 5 weight percent of metal-containing nanoparticles made by the method of claim 7.

17. A lubricant composition comprising:

a base oil of lubricating viscosity; and

a boundary friction reducing amount of a reaction product comprising self-dispersing metal-containing nanoparticles dispersed in the base oil, wherein the reaction product is made by an improved process of reacting a mixture of organo-cerium salt, a fatty acid, and an amine reacted in the absence of solvent at a temperature ranging from about 150° to about 250° C., wherein the improvement comprises reacting the organo-cerium salt, a fatty acid, and an amine in a molar ratio ranging from about 1:1:1 to about 1:2:2 in the reaction mixture under an atmosphere selected from the group consisting of air, oxygen, nitrogen, and argon which is delivered subsurface to the reaction mixture to provide the reaction product comprising from about 20 to about 40 % by weight of the nanoparticles in a substantially organic medium.

18. The lubricant composition of claim 17, wherein the organo-cerium salt comprises cerium (III) acetate.

19. The lubricant composition of claim 17, wherein the substantially organic medium is substantially devoid of water and comprises reaction products of the acid and amine components.

20. The lubricant composition of claim 17, wherein the reaction mixture is substantially devoid of water.

21. The lubricant composition of claim 17, wherein the amount of metal-containing nanoparticles dispersed in the base oil ranges up to about 5 percent by weight.

22. The lubricant composition of claim 17, wherein the nanoparticles are selected from the group consisting of rod-shaped nanoparticles, spherical nanoparticles, and plate shaped nanoparticles having a size ranging from about 1 to about 50 nanometers.

23. The lubricant composition of claim 17, wherein the fatty acid comprises an unsaturated fatty acid containing from about 10 to about 26 carbon atoms.

24. The lubricant composition of claim 17, wherein the amine comprises an unsaturated hydrocarbyl amine containing from about 3 to about 24 carbon atoms.