and ability to dissolve surfactant compounds used in methods for drying or dewatering.

SUMMARY

In one embodiment, disclosed here are compositions comprising a compound having the formula $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In another embodiment, disclosed here are compositions comprising a compound having the formula $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In another embodiment, disclosed herein are compositions comprising a compound having the formula $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In yet another embodiment, disclosed here are compositions comprising a compound having the formula $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In yet another embodiment, disclosed herein are novel methods of using a composition comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3.

In yet another embodiment, disclosed herein are novel methods of manufacturing fluorocarbon ethers, including those above.

In one aspect, there is provided an unsaturated fluoroether comprising a compound having the formula $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In another aspect, there is provided an unsaturated fluoroether comprising a compound having the formula $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

In yet another aspect, there is provided a method for removing residue from a surface comprising:

a. contacting the surface with a composition comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3.

b. recovering the surface from the composition.

In still another aspect, there is provided a method for depositing a fluorolubricant on a surface comprising:

a. combining a fluorolubricant and a solvent, said solvent comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3, to form a lubricant-solvent combination;

b. contacting the combination of lubricant-solvent with the surface; and

c. evaporating the solvent from the surface to form a fluorolubricant coating on the surface.

The foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as defined in the appended claims.

CLAIMS

What is claimed is:

1. An unsaturated fluoroether comprising a compound having the formula $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

2. The composition of claim 1, further comprising a compound having the formula $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

3. An unsaturated fluoroether comprising a compound having the formula $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

4. The composition of claim 1, wherein R is C_2H_5.

5. The composition of claim 1 wherein R is CH_3.

6. A method for removing residue from a surface comprising:
   a. contacting the surface with a composition comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3.
   b. recovering the surface from the composition.

7. The method of claim 6 wherein said composition further comprises a propellant.

8. The method of claim 7 wherein said propellant is selected from the group consisting of air, nitrogen, carbon dioxide, difluoromethane (CF_2H_2, HFC-32), trifluoromethane (CF_3H, HFC-23), difluoroethane (CHF_2CH_3, HFC-152a), trifluoroethane (CH_3CF_3, HFC-143a; or CHF_2CH_2F, HFC-143), tetrafluoroethane (CF_3CH_2F, HFC-134a; or CF_2HCF_2H, HFC-134), pentafluoroethane (CF_3CF_2H, HFC-125), 1,3,3,3-tetrafluoro-1-propene (HFO-1234ze), 2,3,3,3-tetrafluoro-1-propene (HFO-1234yf), 1,2,3,3,3-pentafluoropropene (HFO-1225ye), 1,1,3,3,3-pentafluoropropene (HFO-1225ze), hydrocarbons, and dimethyl ether.

9. The method of claim 6 wherein said composition further comprises at least one surfactant.

10. The method of claim 6 wherein said contacting is accomplished by vapor degreasing.

11. The method of claim 10, wherein the vapor degreasing is performed by:
    a. Boiling the composition; and
    b. Exposing the article to vapors of the boiling cleaning composition.

12. The method of claim 9, wherein the contacting is accomplished by immersing the article in said composition, wherein the composition is at a temperature greater than ambient or room temperature.

13. The method of claim 12, wherein the composition is at a temperature of about the boiling point of the composition.

14. The method of claim 12 comprising, after immersing the article in the composition, the further step of immersing the article in the composition, wherein the composition is at a temperature lower than that of the first immersing step.

15. The method of claim 14, wherein the composition in the second immersing step is at ambient or room temperature.

16. The method of claim 14 comprising, after the second immersing step, the further steps of boiling the composition and exposing the article to vapors of the boiling composition.

17. The method of claim 6, wherein the composition is at ambient or room temperature.

18. The method of claim 6, wherein the contacting is accomplished by wiping the article with an object soaked in the composition.

19. A method for depositing a fluorolubricant on a surface comprising:
    a. combining a fluorolubricant and a solvent, said solvent comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3, to form a lubricant-solvent combination;
    b. contacting the combination of lubricant-solvent with the surface; and
    c. evaporating the solvent from the surface to form a fluorolubricant coating on the surface.

20. The method of claim 19, wherein the surface is that of a semiconductor material, metal, metal oxide, vapor deposited carbon, or glass.

21. The method of claim 20, wherein the surface is that of a magnetic medium.

22. The method of claim 21, wherein the magnetic medium is a computer disk.

23. The method of claim 19, wherein the contacting step is accomplished by dipping or immersing the surface in a bath comprising the fluorolubricant.

24. The method of claim 19, wherein the contacting step is accomplished by spraying or spin coating the surface with the fluorolubricant.

25. The method of claim 19, wherein the fluorolubricant concentration in the lubricant-solvent combination is from about 0.02 weight percent to about 0.5 weight percent.

26. The method of claim 19, wherein the evaporating step is accomplished at a temperature of from about 10 °C to about 40 °C.

27. The method of claim 19, wherein the fluorolubricant comprises a perfluoropolyether.

28. The method of claim 19, wherein the fluorolubricant is selected from the group consisting of perfluoropolyethers and mixtures thereof.

CLAIMS

What is claimed is:

1. A composition comprising at least one unsaturated fluoroether having a formula selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

2. The composition of claim 1, wherein the unsaturated fluoroether comprises a compound having the formula $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

3. The composition of claim 2, further comprising a compound having the formula $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

4. The composition of claim 1, wherein the unsaturated fluoroether comprises a compound having the formula $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

5. The composition of claim 1, wherein the unsaturated fluoroether comprises a compound having the formula $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

6. The composition of claim 1, wherein the unsaturated fluoroether comprises a compound having the formula $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, wherein R is CH_3 or C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 1, 2 or 3.

7. The composition of claim 2, wherein R is C_2H_5.

8. The composition of claim 2 wherein R is CH_3.

9. A process for preparation of fluorocarbon ethers comprising, contacting a perfluoropentene, perfluorohexene, perfluoroheptene or perfluorooctene with an alcohol, and a strong base, in an aqueous solution, to provide a fluorocarbon ether layer and an aqueous layer, and separating the fluorocarbon ether layer from the aqueous layer to provide the fluorocarbon ether product.

10. The process of claim 9, wherein the contacting step further comprises a phase transfer catalyst.

11. The process of claim 10, wherein the phase transfer catalyst is selected from the group consisting of crown ethers, onium salts, cryptates and polyalkylene glycols and derivatives thereof, and mixtures thereof.

12. The process of claim 9 wherein the strong base is a base which will react with an alcohol to produce an alkoxide upon combination of the base with said alcohol.

13. The process of claim 9, wherein the strong base is an alkali metal hydroxide.

14. The process of claim 9, wherein the alcohol is methanol or ethanol.

15. The process of 9 wherein the perfluoropentene, perfluorohexene, perfluoroheptene or perfluorooctene is selected from the group consisting of perfluoro-2-pentene, perfluoro-2-hexene, perfluoro-3-hexene, perfluoro-2-heptene, perfluoro-3-heptene, perfluoro-2-octene, perfluoro-3-octene and perfluoro-4-octene.

16. A method for removing residue from a surface comprising:
    a. contacting the surface with a composition comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3.
    b. recovering the surface from the composition.

17. The method of claim 16 wherein said composition further comprises a propellant.

18. The method of claim 17 wherein said propellant is selected from the group consisting of air, nitrogen, carbon dioxide, difluoromethane (CF_2H_2, HFC-32), trifluoromethane (CF_3H, HFC-23), difluoroethane (CHF_2CH_3, HFC-152a), trifluoroethane (CH_3CF_3, HFC-143a; or CHF_2CH_2F, HFC-143), tetrafluoroethane (CF_3CH_2F, HFC-134a; or CF_2HCF_2H, HFC-134), pentafluoroethane (CF_3CF_2H, HFC-125), 1,3,3,3-tetrafluoro-1-propene (HFO-1234ze), 2,3,3,3-tetrafluoro-1-propene (HFO-1234yf), 1,2,3,3,3-pentafluoropropene (HFO-1225ye), 1,1,3,3,3-pentafluoropropene (HFO-1225ze), hydrocarbons, and dimethyl ether.

19. The method of claim 16 wherein said composition further comprises at least one surfactant.

20. The method of claim 16 wherein said contacting is accomplished by vapor degreasing.

21. The method of claim 20, wherein the vapor degreasing is performed by:
    a. Boiling the composition; and
    b. Exposing the article to vapors of the boiling cleaning composition.

22. The method of claim 16, wherein the contacting is accomplished by immersing the article in said composition, wherein the composition is at a temperature greater than ambient or room temperature.

23. The method of claim 22, wherein the composition is at a temperature of about the boiling point of the composition.

24. The method of claim 22 comprising, after immersing the article in the composition, the further step of immersing the article in the composition, wherein the composition is at a temperature lower than that of the first immersing step.

25. The method of claim 24, wherein the composition in the second immersing step is at ambient or room temperature.

26. The method of claim 24 comprising, after the second immersing step, the further steps of boiling the composition and exposing the article to vapors of the boiling composition.

27. The method of claim 16, wherein the composition is at ambient or room temperature.

28. The method of claim 16, wherein the contacting is accomplished by wiping the article with an object soaked in the composition.

29. A method for depositing a fluorolubricant on a surface comprising:
    a. combining a fluorolubricant and a solvent, said solvent comprising at least one unsaturated fluoroether selected from the group consisting of $CF_3(CF_2)_xCF=CFCF(OR)(CF_2)_yCF_3$, $CF_3(CF_2)_xC(OR)=CFCF_2(CF_2)_yCF_3$, $CF_3CF=CFCF(OR)(CF_2)_x(CF_2)_yCF_3$, $CF_3(CF_2)_xCF=C(OR)CF_2(CF_2)_yCF_3$, and mixtures thereof, wherein R can be either CH_3, C_2H_5 or mixtures thereof, and wherein x and y are independently 0, 1, 2 or 3, and wherein x + y = 0, 1, 2 or 3, to form a lubricant-solvent combination;
    b. contacting the combination of lubricant-solvent with the surface; and
    c. evaporating the solvent from the surface to form a fluorolubricant coating on the surface.

30. The method of claim 29, wherein the surface is that of a semiconductor material, metal, metal oxide, vapor deposited carbon, or glass.

31. The method of claim 30, wherein the surface is that of a magnetic medium.

32. The method of claim 31, wherein the magnetic medium is a computer disk.

33. The method of claim 29, wherein the contacting step is accomplished by dipping or immersing the surface in a bath comprising the fluorolubricant.

34. The method of claim 29, wherein the contacting step is accomplished by spraying or spin coating the surface with the fluorolubricant.

35. The method of claim 29, wherein the fluorolubricant concentration in the lubricant-solvent combination is from about 0.02 weight percent to about 0.5 weight percent.

36. The method of claim 29, wherein the evaporating step is accomplished at a temperature of from about 10 °C to about 40 °C.

37. The method of claim 29, wherein the fluorolubricant comprises a perfluoropolyether.

38. The method of claim 29, wherein the fluorolubricant is selected from the group consisting of perfluoropolyethers and mixtures thereof.