CLAIMS

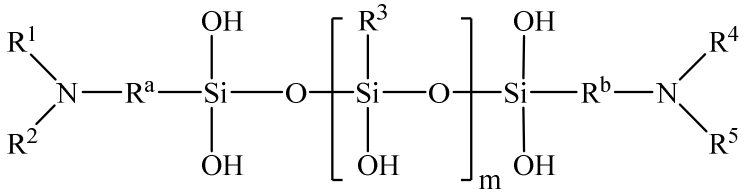
What is claimed is:

1. A composition comprising:

A. approximately 70% or less by weight of neat phosphoric acid;

B. approximately 30% or greater by weight of a mixture comprising at least one of:

I. a compound of Formula I:



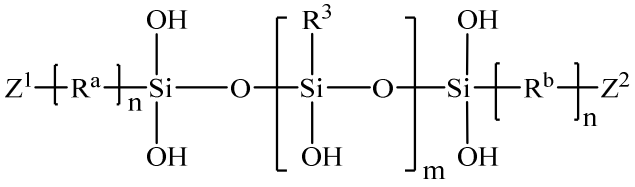
wherein:

(i) m = 0-20,

(ii) each of R^1, R^2, R^3, R^4 and R^5 is independently selected from the group of hydrogen, a C_1 to C_{10} linear alkyl group, a C_1 to C_{10} linear alkyl group substituted with fluorine, a nitrogen-containing group, an oxygen-containing group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –≀–OH, and

(iii) each of R^a and R^b is independently selected from a C_1 to C_{10} linear alkyl group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –≀–NH-C_1-C_{10} alkyl, a C_1-C_{10} alkyl substituted with –≀–OH; ~~and~~or

II. a compound of Formula II:



wherein:

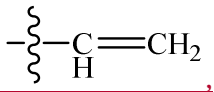
(i) m = 0-20,

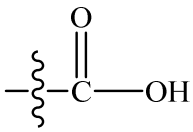
(ii) n =0-20,

(iii) R^3 is selected from the group of hydrogen, a C_1 to C_{10} linear alkyl group, a C_1 to C_{10} linear alkyl group substituted with fluorine, a nitrogen-containing group, an oxygen-containing group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –§–OH, Z^1 and Z^2, and

(iv) each of R^a and R^b is independently selected from a C_1 to C_{10} linear alkyl group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –§–NH-C_1-C_{10} alkyl, a C_1-C_{10} alkyl substituted with –§–OH,

(v) Z^1 and Z^2 are each independently selected from:

a. ,

b. ,

c. –§–$N^+(CH_3)_3Cl^-$, and

d. –§–$CH(OH)CH_2OH$; and

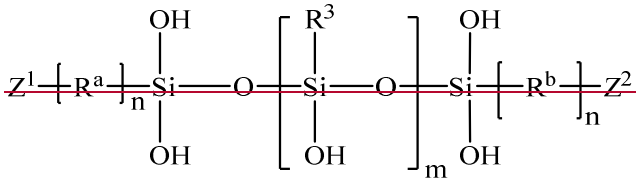
III. an aqueous solvent.

~~**2.** A composition comprising:~~

~~**A.** approximately 70% or less by weight of neat phosphoric acid;~~

~~**B.** approximately 30% or greater by weight of a mixture comprising:~~

~~**I.** a compound of Formula II:~~



~~wherein:~~

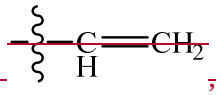
~~**(i)** m = 0-20,~~

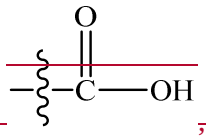
~~**(ii)** n =0-20,~~

(iii) R^3 is selected from the group of hydrogen, a C_1 to C_{10} linear alkyl group, a C_1 to C_{10} linear alkyl group substituted with fluorine, a nitrogen-containing group, an oxygen-containing group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, $\lesssim$ OH, Z^1 and Z^2, and

(iv) each of R^a and R^b is independently selected from a C_1 to C_{10} linear alkyl group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, $\lesssim$ NH C_1-C_{10} alkyl, a C_1-C_{10} alkyl substituted with $\lesssim$ OH,

(v) Z^1 and Z^2 are each independently selected from:

a. ;

b. ;

c. $\lesssim N^+(CH_3)_3Cl^-$, and

d. $\lesssim CH(OH)CH_2OH$; and

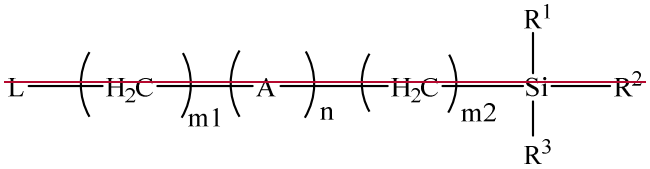
II. an aqueous solvent.

3. A composition comprising:

A. approximately 70% or less by weight of neat phosphoric acid;

B. approximately 30% or greater by weight of a mixture comprising:

I. a compound of Formula III:



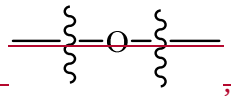
wherein:

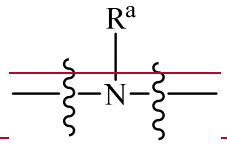
(i) m1 and m2 each equal 0-10 provided and at least one of m1 and m2 is ≥ 1,

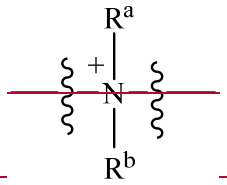
(ii) n = 0 or 1,

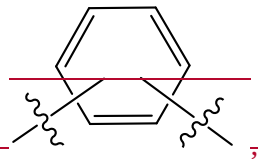
(iii) each of R^1, R^2 and R^3 is independently selected from the group of hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group and a $\overset{\xi}{\xi}$-O-C_1 to C_6 linear alkyl group,

(iv) A is selected from:

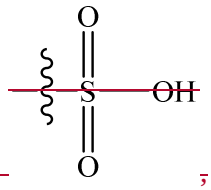
a.  ;

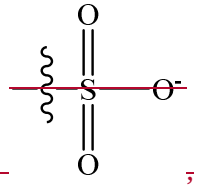
b.  wherein R^a is selected from hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group,

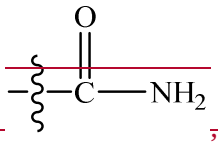
c.  wherein R^a and R^b are each independently selected from hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group and

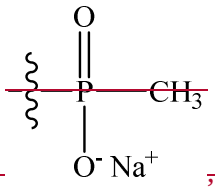
d.  ;

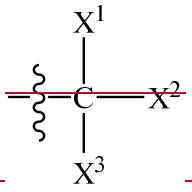
(v) L is selected from:

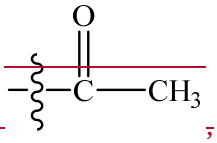
a.  ;

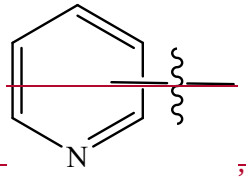
b.  ,

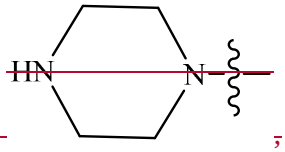
c.  ;

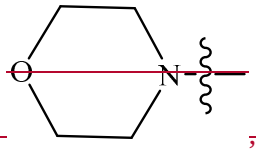
d.  ;

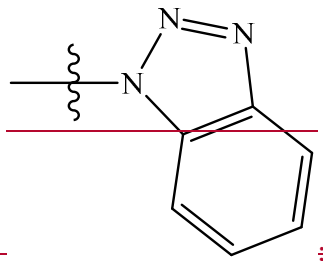
e.  wherein each of X^1, X^2 and X^3 is independently selected from Cl, Br, F or I,

f.  ;

g.  ;

h.  ;

i.  ; and

j.  ; and

II. an aqueous solvent.

~~4. The composition of any of claims 1-3, wherein the mixture further comprises at least one additional acid other than neat phosphoric acid.~~

~~5.~~2. The composition of ~~any of claims 1-3~~claim 1, wherein the mixture further comprises at least one additional acid other than neat phosphoric acid selected from HNO_3, H_2SO_4, HCl and methane sulfuric acid.

~~6. The composition of any of claims 1-3, wherein the mixture further comprises neat sulfuric acid.~~

~~7. The composition of any of claims 1-3, wherein the mixture further comprises approximately 25% or less by weight of neat sulfuric acid.~~

~~8. The composition of any of claims 1-3, wherein the mixture further comprises neat methane sulfuric acid.~~

~~9. The composition of any of claims 1-3, wherein the mixture further comprises a sulfonic acid.~~

~~10.~~3. The composition of ~~any of claims 1-3~~claim 1, wherein (i) the mixture further comprises neat sulfuric acid and (ii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

~~11.~~4. The composition of ~~any of claims 1-3~~claim 1, wherein (i) the mixture further comprises sulfuric acid and (ii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

~~12. The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 7.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~13. The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 6.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~14. The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 5.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~15. The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 4.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**16.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 3.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**17.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.0 parts by weight to approximately 2.5 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**18.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 3.0 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**19.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.25 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**20.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.5 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**21.** The composition of any of claims 1-3, wherein (i) the mixture further comprises neat sulfuric acid and (ii) there is approximately 2.75 parts by weight of neat phosphoric acid per 1 part by weight of neat sulfuric acid.~~

~~**22.** The composition of any of claims 1-3, wherein the aqueous solvent comprises water.~~

~~**23.** The composition of any of claims 1-3, wherein the aqueous solvent consists essentially of water.~~

~~**24.** The composition of any of claims 1-3, wherein the aqueous solvent consists of water.~~

~~**25.**~~**5.** The composition of ~~any of claims 1-3~~claim 1, wherein the mixture further comprises one or more additional silicon-containing compound selected from alkylsilsesquioxanes, vinylsilsesquioxane, carboxylic acid alkylsilsesquioxane and alkyleneglycol alkylsilsesquioxane.

~~**26.** The composition of any of claims 1-3, wherein a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.~~

~~**27.** The composition of any of claims 1-3, wherein a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.~~

~~**28.** The composition of any of claims 1-3, wherein the formula consists essentially of the neat phosphoric acid and the mixture.~~

~~**29.** The composition of any of claims 1-3, wherein the formula consists of the neat phosphoric acid and the mixture.~~

~~**30.** The composition of claim 1, wherein the formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the compound of Formula I and the aqueous solvent.~~

~~**31.**__6.__ The composition of claim 1, wherein the ~~formula consists of the neat phosphoric acid and the mixture the mixture consists of the~~mixture comprises a compound of Formula I and the aqueous solvent.

~~**32.**__7.__ The composition of ~~claim 2~~claim 1, wherein the ~~formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the~~mixture comprises a compound of Formula II ~~and the aqueous solvent~~.

~~**33.** The composition of claim 2, wherein the formula consists of the neat phosphoric acid and the mixture the mixture consists of the compound of Formula II and the aqueous solvent.~~

~~**34.** The composition of claim 3, wherein the formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the compound of Formula III and the aqueous solvent.~~

~~**35.** The composition of claim 3, wherein the formula consists of the neat phosphoric acid and the mixture the mixture consists of the compound of Formula III and the aqueous solvent.~~

~~**36.**__8.__ The composition of claim 1, wherein m in one or both of Formula I and Formula II is 0.

~~**37.**__9.__ The composition of claim 1, wherein a content of the compound of Formula I is approximately 5% or less by weight.

~~**38.** The composition of claim 1, wherein a content of the compound of Formula I is approximately 4% or less by weight.~~

~~**39.** The composition of claim 1, wherein a content of the compound of Formula I is approximately 3% or less by weight.~~

~~**40.** The composition of claim 1, wherein a content of the compound of Formula I is approximately 2% or less by weight.~~

~~**41.** The composition of claim 1, wherein a content of the compound of Formula I is approximately 1% or less by weight.~~

~~**42.** The composition of claim 1, wherein each of R^1, R^2, R^3, R^4 and R^5 is the same.~~

~~**43.** The composition of claim 1, wherein each of R^1, R^2, R^3, R^4 and R^5 is hydrogen.~~

~~**44.** The composition of claim 1, wherein at least one of R^1, R^2, R^3, R^4 and R^5 is something other than hydrogen.~~

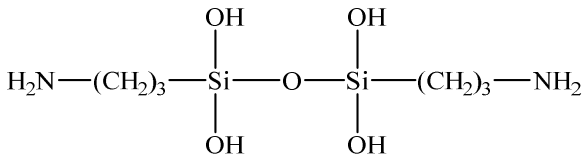
~~**45.** The composition of claim 1, wherein (i) each of R^a and R^b is ~~§~~ C_3H_6 ~~§~~, (ii) each of R^1, R^2, R^4 and R^5 is ~~§~~ H and (iii) m = 0.~~

~~**46.** The composition of claim 1, wherein (i) each of R^a and R^b is ~~§~~ C_3H_6 ~~§~~, (ii) each of R^1, R^2, R^4 and R^5 is ~~§~~ H and (iii) m = 0.~~

~~**47.** The composition of claim 1, wherein (i) each of R^a and R^b is ~~§~~ NH C_2H_4, (ii) each of R^1, R^2, R^3, R^4 and R^5 is ~~§~~ H and (iii) m = 0.~~

~~**48.**~~**10.** The composition of claim 1, comprising a compound of Formula I, wherein

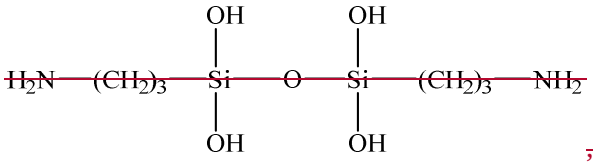
(i) the compound of Formula I ~~is~~comprises:



.

~~**49.** The composition of claim 1, wherein~~

~~**(i)** the compound of Formula I is:~~

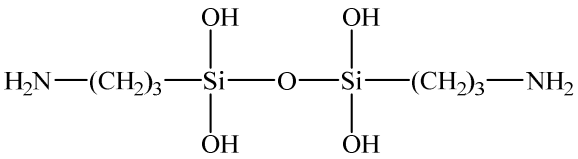


~~, and~~

~~**(ii)** the mixture further comprises neat sulfuric acid.~~

~~**50.**~~**11.** The composition of claim 1, comprising a compound of Formula I, wherein

(i) the compound of Formula I ~~is~~comprises:

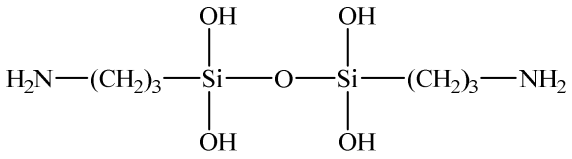


(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

~~51.~~**12.** The composition of claim 1, comprising a compound of Formula I, wherein

(i) the compound of Formula I ~~is~~comprises:

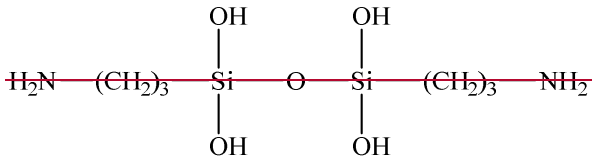


(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

~~**52.** The composition of claim 1, wherein~~

~~(i) the compound of Formula I is:~~

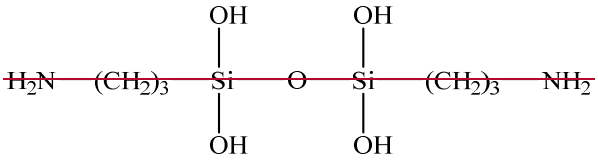


~~**(ii)** the mixture further comprises sulfuric acid, and~~

~~**(iii)** a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.83% by weight of the composition.~~

~~**53.** The composition of claim 1, wherein~~

~~**(i)** the compound of Formula I is:~~

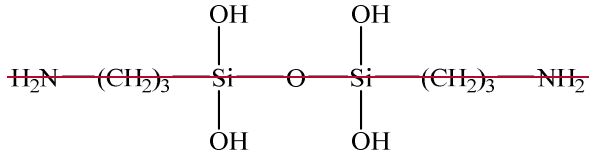


~~**(ii)** the mixture further comprises sulfuric acid, and~~

~~**(iii)** a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.94% by weight of the composition.~~

~~**54.** The composition of claim 1, wherein~~

~~**(i)** the compound of Formula I is:~~

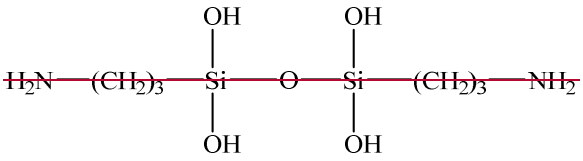


~~**(ii)** the mixture further comprises sulfuric acid, and~~

~~**(iii)** a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 84.27% by weight of the composition.~~

~~**55.** The composition of claim 1, wherein~~

~~**(i)** the compound of Formula I is:~~

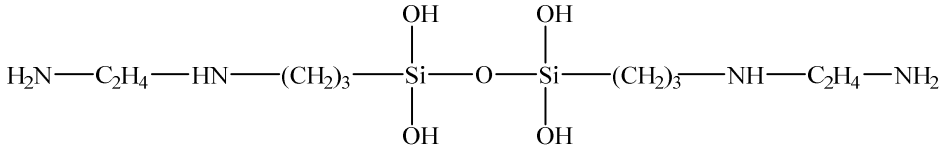


~~**(ii)** the mixture further comprises sulfuric acid, and~~

~~**(iii)** a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 84.6% by weight of the composition.~~

~~**56.**~~**13.** The composition of claim 1, comprising a compound of Formula I, wherein

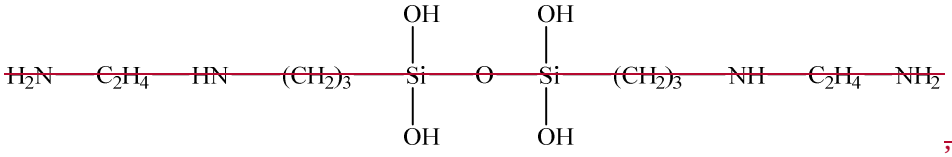
(i) the compound of Formula I ~~is~~comprises:



.

~~**57.** The composition of claim 1, wherein~~

~~**(i)** the compound of Formula I is:~~

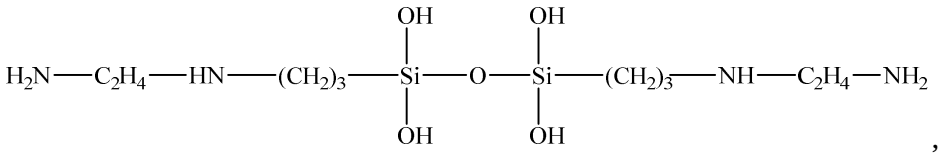


~~, and~~

~~**(ii)** the mixture further comprises neat sulfuric acid.~~

~~**58.**~~**14.** The composition of claim 1, comprising a compound of Formula I, wherein

(i) the compound of Formula I ~~is~~comprises:



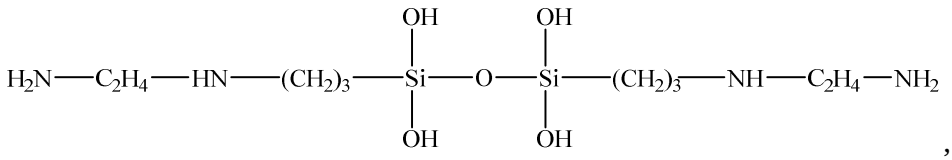
,

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

~~**59.**~~**15.** The composition of claim 1, comprising a compound of Formula I, wherein

(i) the compound of Formula I ~~is~~comprises:



,

(ii) the mixture further comprises sulfuric acid, and

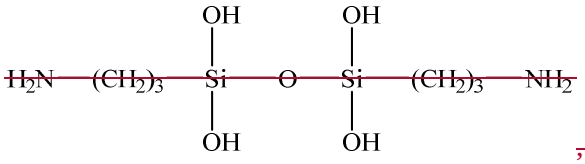
(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

~~**60.** A composition comprising:~~

~~**A.** approximately 60% or less by weight of neat phosphoric acid;~~

~~**B.** approximately 40% or greater by weight of a mixture comprising:~~

~~**(i)** approximately 5% or less by weight of:~~



~~, and~~

~~**(ii)** approximately 24% or less by weight of neat sulfuric acid; and~~

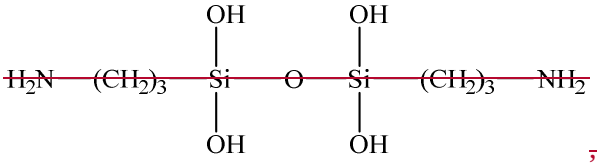
~~**(iii)** an aqueous solvent comprising water.~~

~~**61.** A composition consisting essentially of:~~

~~**A.** approximately 60% or less by weight of neat phosphoric acid;~~

~~**B.** approximately 40% or greater by weight of a mixture consisting essentially of:~~

~~**(i)** approximately 5% or less by weight of:~~



~~, and~~

~~**(ii)** approximately 24% or less by weight of neat sulfuric acid; and~~

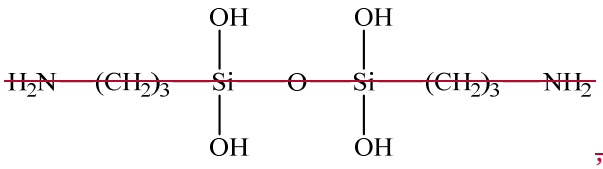
~~**(iii)** an aqueous solvent consisting essentially of water.~~

~~**62.** A composition consisting of:~~

~~**A.** approximately 60% or less by weight of neat phosphoric acid;~~

~~**B.** approximately 40% or greater by weight of a mixture consisting of:~~

~~**(i)** approximately 5% or less by weight of:~~



, and

(ii) approximately 24% or less by weight of neat sulfuric acid; and

(iii) an aqueous solvent consisting of water.

63. The composition of claim 2, wherein m is 0.

64. The composition of claim 2, wherein n is 0.

65. The composition of claim 2, wherein m is 0 and n is 0.

66.16 The composition of claim 2claim 1, wherein a content of the compound of Formula II is approximately 5% or less by weight.

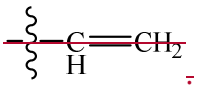
67. The composition of claim 2, wherein a content of the compound of Formula II is approximately 4% or less by weight.

68. The composition of claim 2, wherein a content of the compound of Formula II is approximately 3% or less by weight.

69. The composition of claim 2, wherein a content of the compound of Formula II is approximately 2% or less by weight.

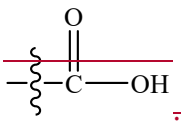
70. The composition of claim 2, wherein a content of the compound of Formula II is approximately 1% or less by weight.

71. The composition of claim 2, wherein (i) m = 0 and n=3 (ii) each of Z^1 and Z^2 is



.

72. The composition of claim 2, wherein (i) m = 0, (ii) n = 3 and (iii) each of Z^1 and Z^2 is



.

73. The composition of claim 2, wherein (i) m = 0, (ii) n = 3 and (ii) each of Z^1 and Z^2 is



.

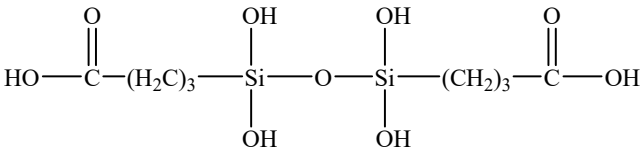
74. The composition of claim 2, wherein (i) m = 0, (ii) n =3 and (iii) each of Z^1 and Z^2 is



.

75.17. The composition of claim 2claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II iscomprises:

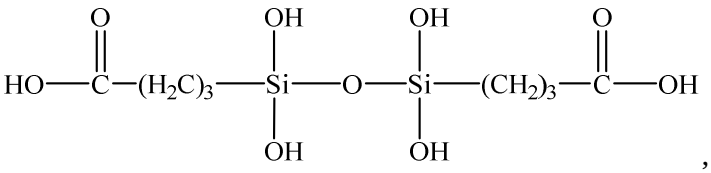


~~, and~~

~~**(ii)** the mixture further comprises neat sulfuric acid~~.

~~**76.**~~**18.** The composition of ~~claim 2~~claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II ~~is~~comprises:



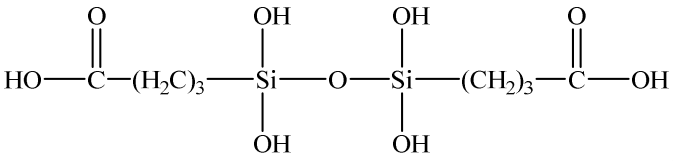
,

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

~~**77.**~~**19.** The composition of ~~claim 2~~claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II ~~is~~comprises:



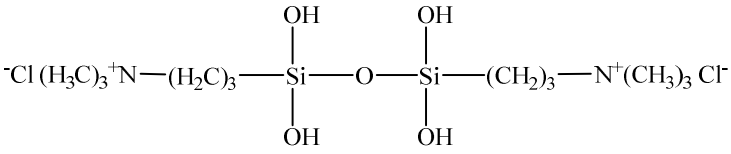
,

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

~~**78.**~~**20.** The composition of ~~claim 2~~claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II ~~is~~comprises:

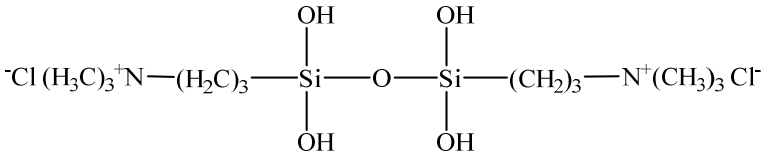


~~, and~~

~~**(ii)** the mixture further comprises neat sulfuric acid~~.

~~**79.**~~**21.** The composition of ~~claim 2~~claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II ~~is~~comprises:



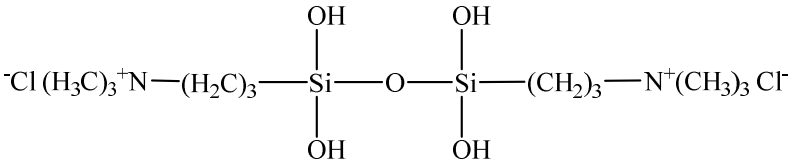
,

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

~~**80.**~~**22.** The composition of ~~claim 2~~claim 1, comprising a compound of Formula II, wherein

(i) the compound of Formula II ~~is~~comprises:



,

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

~~**81.** The composition of claim 3, wherein a content of the compound of Formula III is approximately 5% or less by weight.~~

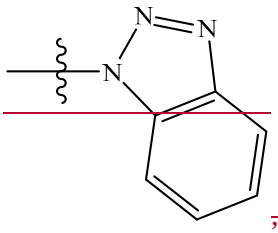
~~**82.** The composition of claim 3, wherein a content of the compound of Formula III is approximately 4% or less by weight.~~

~~**83.** The composition of claim 3, wherein a content of the compound of Formula III is approximately 3% or less by weight.~~

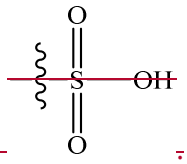
~~**84.** The composition of claim 3, wherein a content of the compound of Formula III is approximately 2% or less by weight.~~

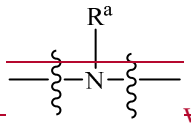
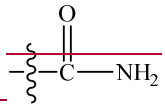
~~**85.** The composition of claim 3, wherein a content of the compound of Formula III is approximately 1% or less by weight.~~

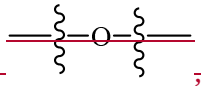
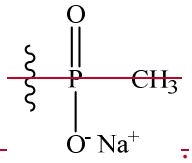
~~**86.** The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $\S\ OCH_3$ **(ii)** L is~~

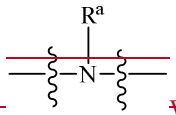
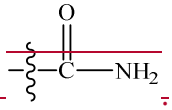


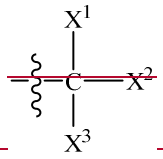
~~, **(iii)** n = 0 and **(iv)** a sum of m1 and m2 = 1-5.~~

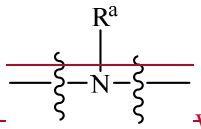
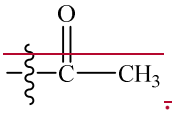
87. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is ~~§~~ OH and **(ii)** a sum of m1 and m2 = 3, **(iii)** n = 0 and (iv) L is .

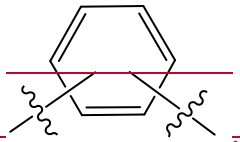
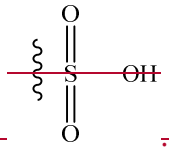
88. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is ~~§~~ OCH_3 and **(ii)** m2 = 3, **(iii)** n = 1, (iv) A is  wherein Ra = H, **(v)** m1 = 0, and **(vi)** L is .

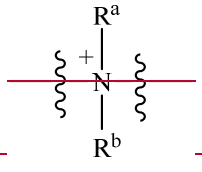
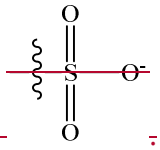
89. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is ~~§~~ OH and **(ii)** m2 = 3, **(iii)** n = 1, **(iv)** A is , **(v)** m1 = 0, and **(vi)** L is .

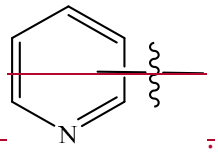
90. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is ~~§~~ OCH_3 and **(ii)** m2 = 3, **(iii)** n = 1, (iv) A is  wherein Ra = ~~§~~ H, **(v)** m1 = 0, and **(vi)** L is .

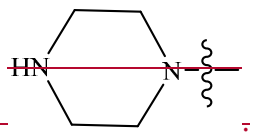
91. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is ~~§~~ OCH_3 and **(ii)** a sum of m1 and m2 = 2, **(iii)** n = 0 and **(iv)** L is  wherein each of X^1, X^2 and X^3 is ~~§~~ F.

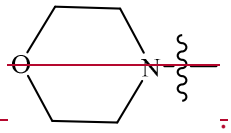
92. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OCH_3$ and **(ii)** m2 = 3, **(iii)** n = 1, **(iv)** A is  wherein Ra = H, **(v)** m1 = 0, and **(vi)** L is .

93. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OH$ and **(ii)** m2 = 2, **(iii)** n = 1, (iv) A is , **(v)** m1 = 0 and **(vi)** L is .

94. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OCH_3$ and **(ii)** m2 = 3, **(iii)** n = 1, **(iv)** A is  wherein R^a and R^b are $-CH_3$, **(v)** m1 = 3 and **(vi)** L is .

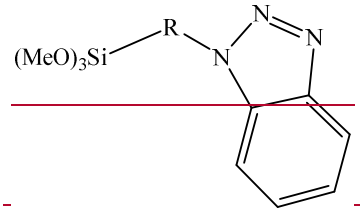
95. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OCH_3$ and **(ii)** a sum of m1 and m2 = 2, **(iii)** n = 0 and **(iv)** L is .

96. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OCH_2CH_3$ and **(ii)** a sum of m1 and m2 = 3, **(iii)** n = 0 and **(iv)** L is .

97. The composition of claim 3, wherein **(i)** each of R^1, R^2 and R^3 is $-OCH_2CH_3$ and **(ii)** a sum of m1 and m2 = 1, **(iii)** n = 0 and **(iv)** L is .

98. The composition of claim 3, wherein

(i) the compound of Formula III is:

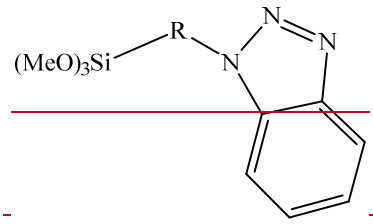


wherein R = $-(CH_2)_x-$ and x=1-5, and

(ii) the mixture further comprises neat sulfuric acid.

99. The composition of claim 3, wherein

(i) the compound of Formula III is:



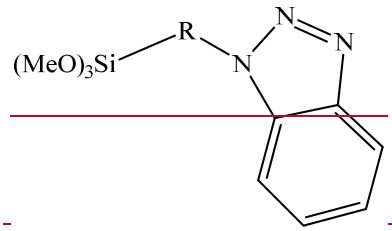
wherein R = $-(CH_2)_x-$ and x=1-5,

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

100. The composition of claim 3, wherein

(i) the compound of Formula III is:



wherein R = $-(CH_2)_x-$ and x=1-5,

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

101. The composition of claim 3, wherein

(i) the compound of Formula III is $Si(OCH_3)_3(CH_2CH_2CF_3)$, and

(ii) the mixture further comprises neat sulfuric acid.

102. The composition of claim 3, wherein

(i) the compound of Formula III is $Si(OCH_3)_3(CH_2CH_2CF_3)$,

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

103. The composition of claim 3, wherein

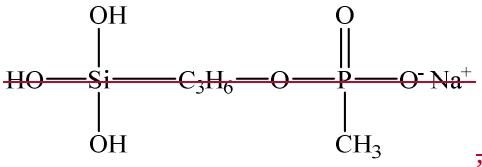
(i) the compound of Formula III is $Si(OCH_3)_3(CH_2CH_2CF_3)$,

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

104. The composition of claim 3, wherein

(i) the compound of Formula III is

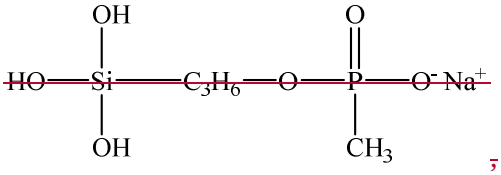


, and

(ii) the mixture further comprises neat sulfuric acid.

105. The composition of claim 3, wherein

(i) the compound of Formula III is



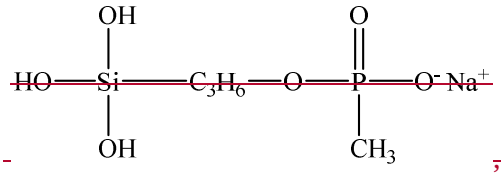
;

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

106. The composition of claim 3, wherein

(i) the compound of Formula III is



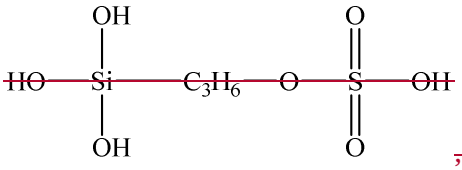
;

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

107. The composition of claim 3, wherein

(i) the compound of Formula III is

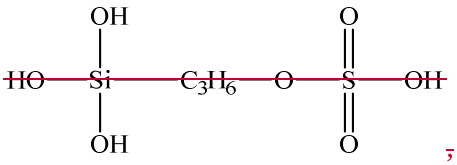


, and

(ii) the mixture further comprises neat sulfuric acid.

108. The composition of claim 3, wherein

(i) the compound of Formula III is



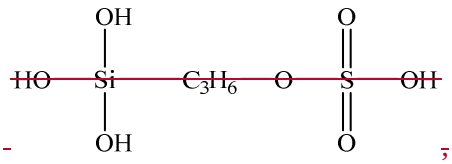
;

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

109. The composition of claim 3, wherein

(i) the compound of Formula III is



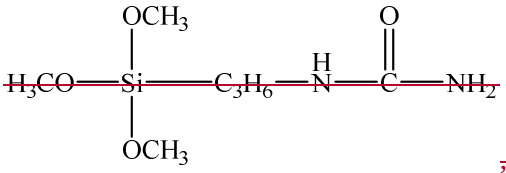
;

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

110. The composition of claim 3, wherein

(i) the compound of Formula III is

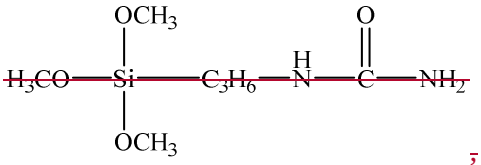


, and

(ii) the mixture further comprises neat sulfuric acid.

111. The composition of claim 3, wherein

(i) the compound of Formula III is



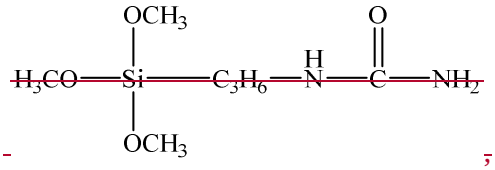
;

(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

112. The composition of claim 3, wherein

(i) the compound of Formula III is



;

(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.5% by weight of the composition.

113. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 2700.

114. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 2500 or greater.

115. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 2250 or greater.

116. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 2000 or greater.

117. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 1500 or greater.

118. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 1250 or greater.

119. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 1000 or greater.

120. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 500 or greater.

121. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide of approximately 300 or greater.

122. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide is between approximately 1500 and approximately 2700.

123. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide is between approximately 2000 and approximately 2700.

124. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide is between approximately 2250 and approximately 2700.

125. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide is between approximately 2500 and approximately 2700.

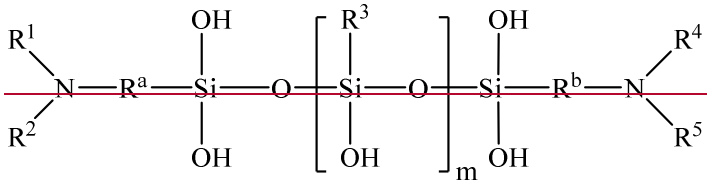
126. The composition of any of claims 1-3, wherein the composition has a selectivity of etch for silicon nitride over silicon oxide is between approximately 2600 and approximately 2700.

127. A composition comprising:

A. greater than approximately 70% by weight of neat phosphoric acid;

B. less than approximately 30% by weight of a mixture comprising:

I. a compound of Formula I:



wherein:

(i) M = 0-20,

(ii) each of R^1, R^2, R^3, R^4 and R^5 is independently selected from the group of hydrogen, a C_1 to C_{10} linear alkyl group, a C_1 to C_{10} linear alkyl group substituted with fluorine, a nitrogen-containing group, an oxygen-containing group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic

alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –OH, and

(iii) each of R^a and R^b is independently selected from a C_1 to C_{10} linear alkyl group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –NH C_1-C_{10} alkyl, a C_1-C_{10} alkyl substituted with –OH; and

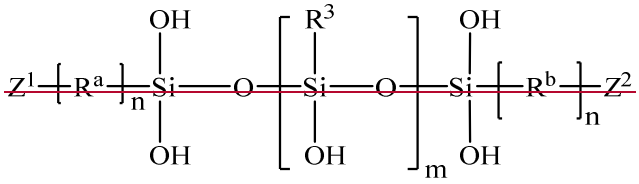
II. an aqueous solvent.

128. A composition comprising:

A. greater than approximately 70% by weight of neat phosphoric acid;

B. less than approximately 30% by weight of a mixture comprising:

I. a compound of Formula II:



wherein:

(i) m = 0-20,

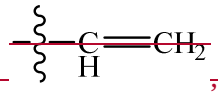
(ii) n = 0-20,

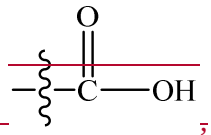
(iii) R^3 is selected from the group of hydrogen, a C_1 to C_{10} linear alkyl group, a C_1 to C_{10} linear alkyl group substituted with fluorine, a nitrogen-containing group, an oxygen-containing group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl group and a C_2 to C_{10} linear or branched alkynyl group, –OH, Z^1 and Z^2, and

(iv) each of R^a and R^b is independently selected from a C_1 to C_{10} linear alkyl group, a C_3 to C_{10} branched alkyl group, a C_3 to C_{10} cyclic alkyl group, a C_5 to C_{12} aryl group, a C_2 to C_{10} linear or branched alkenyl

group and a C_2 to C_{10} linear or branched alkynyl group, §, NH C_1-C_{10} alkyl, a C_1-C_{10} alkyl substituted with §, OH,

(v) Z^1 and Z^2 are each independently selected from:

a. ;

b. ;

c. §, $N^+(CH_3)_3Cl^-$, and

d. §, $CH(OH)CH_2OH$; and

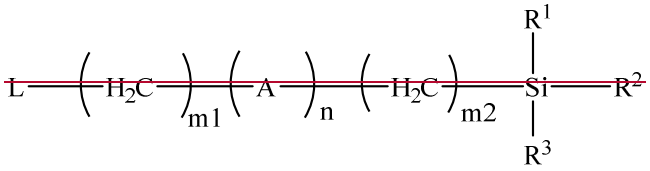
II. an aqueous solvent.

129. A composition comprising:

A. greater than approximately 70% by weight of neat phosphoric acid;

B. less than approximately 30% by weight of a mixture comprising:

I. a compound of Formula III:



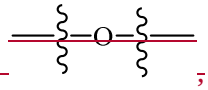
wherein:

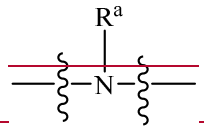
(i) m1 and m2 each equal 0-10 provided and at least one of m1 and m2 is ≥ 1,

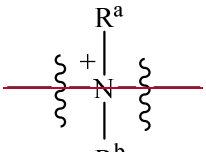
(ii) n = 0 or 1,

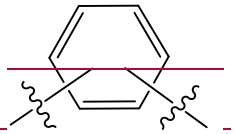
(iii) each of R^1, R^2 and R^3 is independently selected from the group of hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group and a §, O C_1 to C_6 linear alkyl group,

(iv) A is selected from:

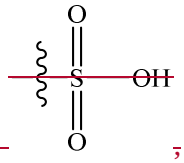
a. ;

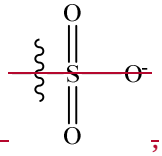
b.  wherein R^a is selected from hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group,

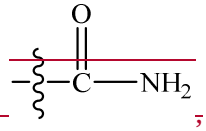
c.  wherein R^a and R^b are each independently selected from hydrogen, a C_1 to C_6 linear alkyl group, a C_3 to C_6 branched alkyl group and

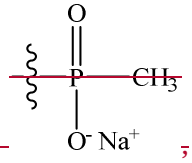
d. ;

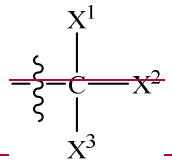
(v) L is selected from:

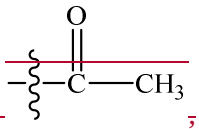
a. ;

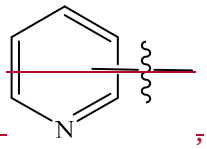
b. ;

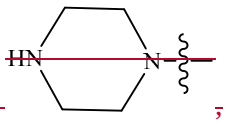
c. ;

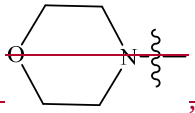
d. ;

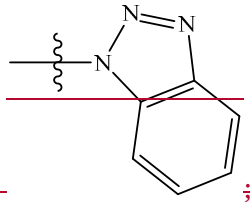
e.  wherein each of X^1, X^2 and X^3 is independently selected from Cl, Br, F or I,

f.  ;

g.  ;

h.  ;

i.  ; and

j.  ; and

II. an aqueous solvent.

130. The composition of any of claims 127-129, wherein (i) the composition comprises greater than approximately 75% by weight of neat phosphoric acid and (ii) less than approximately 25% by weight of a mixture.

131. The composition of any of claims 127-129, wherein the mixture further comprises at least one additional acid other than neat phosphoric acid.

132. The composition of any of claims 127-129, wherein the mixture further comprises at least one additional acid other than neat phosphoric acid selected from HNO_3, H_2SO_4, HCl and methane sulfuric acid.

133. The composition of any of claims 127-129, wherein the mixture further comprises neat sulfuric acid.

134. The composition of any of claims 127-129, wherein the mixture further comprises approximately 10% or less by weight of neat sulfuric acid.

135. The composition of any of claims 127-129, wherein the mixture further comprises neat methane sulfuric acid.

136. The composition of any of claims 127-129, wherein the mixture further comprises a sulfonic acid.

137. The composition of any of claims 127-129, wherein the aqueous solvent comprises water.

138. The composition of any of claims 127-129, wherein the aqueous solvent consists essentially of water.

139. The composition of any of claims 127-129, wherein the aqueous solvent consists of water.

140. The composition of any of claims 127-129, wherein the mixture further comprises one or more additional silicon-containing compound selected from alkylsilsesquioxanes, vinylsilsesquioxane, carboxylic acid alkylsilsesquioxane and alkyleneglycol alkylsilsesquioxane.

141. The composition of any of claims 127-129, wherein the formula consists essentially of the neat phosphoric acid and the mixture.

142. The composition of any of claims 127-129, wherein the formula consists of the neat phosphoric acid and the mixture.

143. The composition of claim 127, wherein the formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the compound of Formula I and the aqueous solvent.

144. The composition of claim 127, wherein the formula consists of the neat phosphoric acid and the mixture the mixture consists of the compound of Formula I and the aqueous solvent.

145. The composition of claim 128, wherein the formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the compound of Formula II and the aqueous solvent.

146. The composition of claim 128, wherein the formula consists of the neat phosphoric acid and the mixture the mixture consists of the compound of Formula II and the aqueous solvent.

147. The composition of claim 129, wherein the formula consists essentially of the neat phosphoric acid and the mixture consists essentially of the compound of Formula III and the aqueous solvent.

148. The composition of claim 129, wherein the formula consists of the neat phosphoric acid and the mixture the mixture consists of the compound of Formula III and the aqueous solvent.

149. The composition of any of claims 127, wherein each of R^1, R^2, R^3, R^4 and R^5 is the same.

150. The composition of any of claims 127, wherein each of R^1, R^2, R^3, R^4 and R^5 is hydrogen.

151. The composition of claim 127, wherein at least one of R^1, R^2, R^3, R^4 and R^5 is something other than hydrogen.

152. The composition of claim 127, wherein a content of the compound of Formula I is approximately 5% or less by weight.

153. The composition of claim 127, wherein a content of the compound of Formula I is approximately 4% or less by weight.

154. The composition of claim 127, wherein a content of the compound of Formula I is approximately 3% or less by weight.

155. The composition of claim 127 wherein a content of the compound of Formula I is approximately 2% or less by weight.

156. The composition of claim 127, wherein a content of the compound of Formula I is approximately 1% or less by weight.

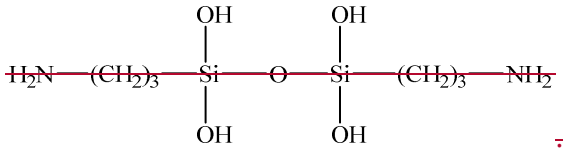
157. The composition of claim 127, wherein **(i)** each of R^a and R^b is $-C_3H_6-$, **(ii)** each of R^1, R^2, R^4 and R^5 is H and **(iii)** m= 0.

158. The composition of claim 127, wherein **(i)** each of R^a and R^b is $-C_3H_6-$, **(ii)** each of R^1, R^2, R^4 and R^5 is H, **(iii)** m = 0 and **(iv)** R^3 = $C_3H_6NH_2$.

159. The composition of claim 128, wherein **(i)** each of R^a and R^b is $-NH-C_2H_4-$, **(ii)** each of R^1, R^2, R^3, R^4 and R^5 is hydrogen and **(iii)** m = 0.

160. The composition of claim 128, wherein

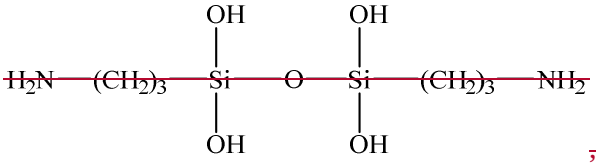
(i) the compound of Formula I is:



.

161. The composition of claim 127, wherein

(i) the compound of Formula I is:

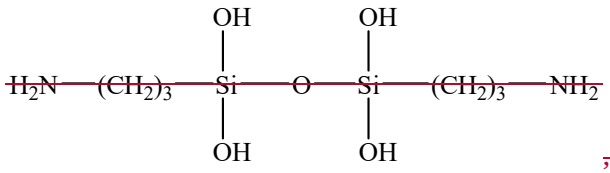


, and

(ii) a content of the neat phosphoric is approximately 80.75% by weight of the composition.

162. The composition of claim 127, wherein

(i) the compound of Formula I is:

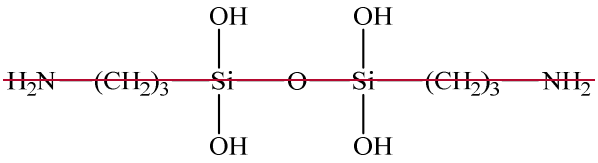


, and

(ii) the mixture further comprises neat sulfuric acid.

163. The composition of claim 127, wherein

(i) the compound of Formula I is:

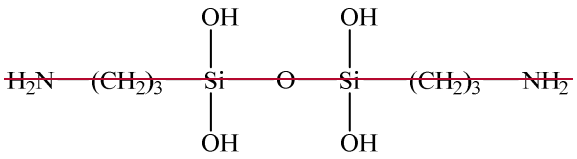


(ii) the mixture further comprises neat sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is between approximately 80% and approximately 85% by weight of the composition.

164. The composition of claim 127, wherein

(i) the compound of Formula I is:

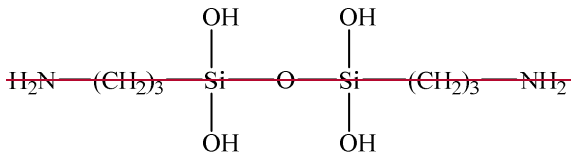


(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 81.85% by weight of the composition.

165. The composition of claim 127, wherein

(i) the compound of Formula I is:

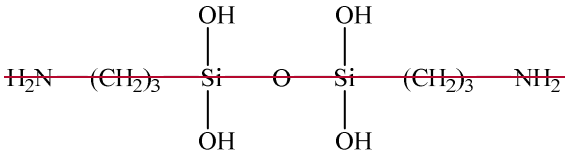


(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 82.4% by weight of the composition.

166. The composition of claim 127, wherein

(i) the compound of Formula I is:

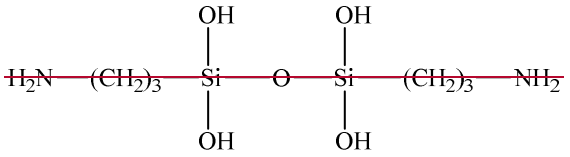


(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 82.95% by weight of the composition.

167. The composition of claim 127, wherein

(i) the compound of Formula I is:

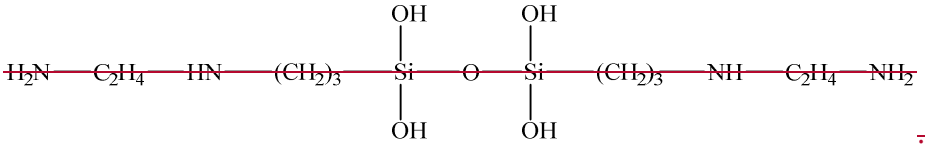


(ii) the mixture further comprises sulfuric acid, and

(iii) a combined content of the neat phosphoric acid and the neat sulfuric acid is approximately 83.23% by weight of the composition.

168. The composition of claim 127, wherein

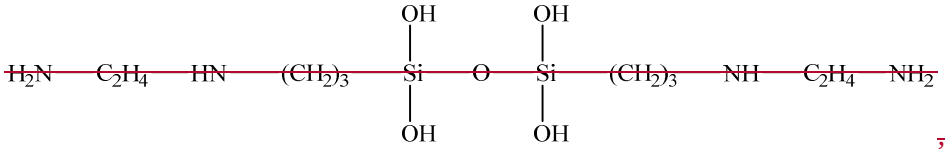
(i) the compound of Formula I is:



.

169. The composition of claim 127, wherein

(i) the compound of Formula I is:

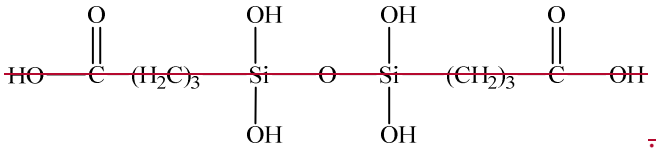


, and

(ii) a content of the neat phosphoric is approximately 80.75% by weight of the composition.

170. The composition of claim 128, wherein

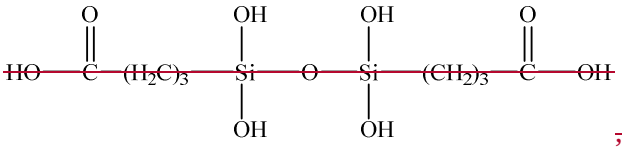
(i) the compound of Formula II is:



.

171. The composition of claim 128, wherein

(i) the compound of Formula II is:

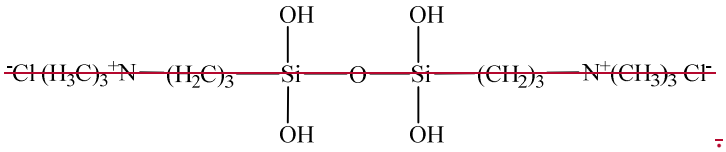


, and

(ii) a content of the neat phosphoric is approximately 80.75% by weight of the composition.

172. The composition of claim 128, wherein

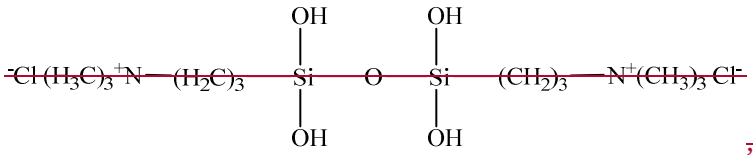
(i) the compound of Formula II is:



.

173. The composition of claim 128, wherein

(i) the compound of Formula II is:

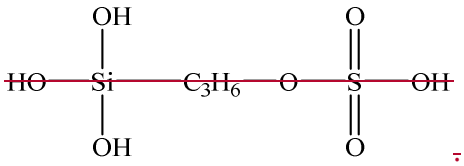


, and

(ii) a content of the neat phosphoric is approximately 80.75% by weight of the composition.

174. The composition of claim 129, wherein

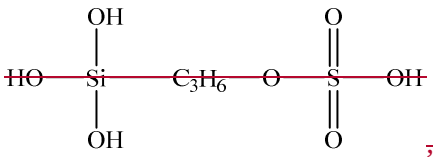
(i) the compound of Formula III is:



.

175. The composition of claim 129, wherein

(i) the compound of Formula III is:

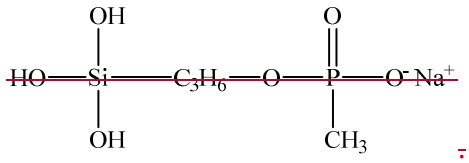


, and

(ii) a content of the neat phosphoric is approximately 80.75% by weight of the composition.

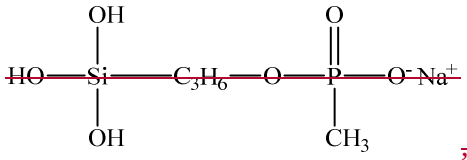
~~**176.** The composition of claim 129, wherein~~

~~**(i)** the compound of Formula III is:~~



~~**177.** The composition of claim 129, wherein~~

~~**(i)** the compound of Formula III is:~~



~~, and~~

~~**(ii)** a content of the neat phosphoric is approximately 80.75% by weight of the composition.~~

~~**178.**~~**23.** A method of selectively enhancing the etch rate of silicon nitride relative to silicon dioxide on a semiconductor substrate comprising silicon nitride and silicon dioxide, the method comprising the steps of:

a. contacting the semiconductor substrate comprising silicon nitride and silicon dioxide with the composition of ~~any of claims 1-177~~claim 1; and

b. rinsing the semiconductor device after the silicon nitride is at least partially removed.

~~**179.** The method of claim 178, further comprising the step of drying the semiconductor device.~~

~~**180.** The method of claim 178, wherein the selectivity of the etch for silicon nitride over silicon oxide is over about 300.~~

~~**181.** The method of claim 178, wherein the contacting step is performed at a temperature of about 160 °C.~~