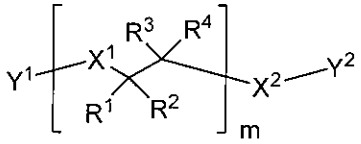
CLAIMS:

1. A chemical-mechanical polishing composition comprising:

(a) about 0.05 wt.% to about 10 wt.% of a ceria abrasive,

(b) about 10 ppm to about 1000 ppm of a polymer of formula I:



I

wherein X^1 and X^2 are independently selected from O, C, and S,

Y^1 and Y^2 are independently selected from OH, C_1-C_{10} alkyl, and a group of the formula: $C_xH_yF_z$,

R^1, R^2, R^3, and R^4 are independently selected from hydrogen, F, C_1-C_{10} alkyl, C_6-C_{10} aryl, and heteroaromatic,

x is an integer of 1 to about 20,

z is an integer of 1 to about 41,

m is an integer of about 3 to about 500, and

at least one of Y^1 or Y^2 is $C_xH_yF_z$ or at least one of R^1-R^4 is F, and

(c) water,

wherein the polishing composition has a pH of about 1 to about 4.5.

2. The polishing composition of claim 1, wherein each of Y^1 and Y^2 is $C_xH_yF_z$.

3. The polishing composition of claim 1, wherein each of X^1 and X^2 is O.

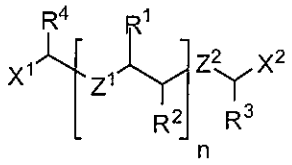
4. The polishing composition of claim 1, wherein each of R^1, R^2, R^3, and R^4 is independently hydrogen or F.

5. The polishing composition of claim 1, wherein x is an integer of 1 to 9.

6. The polishing composition of claim 1, wherein x is an integer of 1 to 8 and y is an integer of 1 to 40.

7. The polishing composition of claim 1, wherein the polymer has a molecular weight of about 500 daltons to about 10,000 daltons, and wherein m is an integer with a value of 8 or greater.

8. The polishing composition of claim 1, wherein the polishing composition further comprises an ionic polymer selected from (a) an ionic polymer of formula II:



II

wherein X^1 and X^2 are independently selected from hydrogen, -OH, and –COOH, and at least one of X^1 and X^2 is -COOH,

Z^1 and Z^2 are independently O or S,

R^1, R^2, R^3, and R^4 are independently selected from hydrogen, C_1-C_6 alkyl, and C_7-C_{10} aryl, and

n is an integer of about 3 to about 500, and

(b) a polyacrylate.

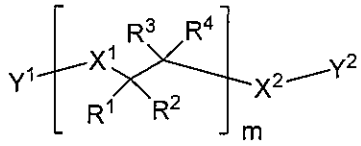
9. The polishing composition of claim 1, wherein the polishing composition further comprises a polyvinyl alcohol.

10. A method of chemically-mechanically polishing a substrate comprising:

(i) contacting a substrate with a polishing pad and a chemical-mechanical polishing composition comprising:

(a) about 0.05 wt.% to about 10 wt.% of a ceria abrasive,

(b) about 10 ppm to about 1000 ppm of a polymer of formula I:



I

wherein X^1 and X^2 are independently selected from O, C, and S,

Y^1 and Y^2 are independently selected from OH, C_1-C_{10} alkyl, and a group of the formula: $C_xH_yF_z$,

R^1, R^2, R^3, and R^4 are independently selected from hydrogen, F, C_1-C_{10} alkyl, C_6-C_{10} aryl, and heteroaromatic,

x is an integer of 1 to about 20,

z is an integer of 1 to about 41,

m is an integer of about 3 to about 500, and

at least one of Y^1 or Y^2 is $C_xH_yF_z$ or at least one of R^1-R^4 is F, and

(c) water,

wherein the polishing composition has a pH of about 1 to about 4.5,

(ii) moving the polishing pad and the chemical-mechanical polishing composition relative to the substrate, and

(iii) abrading at least a portion of the substrate to polish the substrate.

11. The method of claim 10, wherein each of Y^1 and Y^2 is $C_xH_yF_z$.

12. The method of claim 10, wherein each of X^1 and X^2 is O.

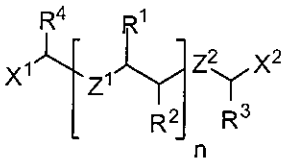
13. The method of claim 10, wherein each of R^1, R^2, R^3, and R^4 is independently hydrogen or F.

14. The method of claim 10, wherein x is an integer of 1 to 9.

15. The method of claim 10, wherein x is an integer of 1 to 8 and y is an integer of 1 to 40.

16. The method of claim 10, wherein the polymer has a molecular weight of about 500 daltons to about 10,000 daltons, and wherein m is an integer with a value of 8 or greater.

17. The method of claim 10, wherein the polishing composition further comprises an ionic polymer selected from (a) an ionic polymer of formula II:



II

wherein X^1 and X^2 are independently selected from hydrogen, -OH, and –COOH, and at least one of X^1 and X^2 is -COOH,

Z^1 and Z^2 are independently O or S,

R^1, R^2, R^3, and R^4 are independently selected from hydrogen, C_1-C_6 alkyl, and C_7-C_{10} aryl, and

n is an integer of about 3 to about 500, and

(b) a polyacrylate.

18. The method of claim 10, wherein the polishing composition further comprises a polyvinyl alcohol.

19. The method of claim 10, wherein the substrate comprises silicon oxide, and wherein at least a portion of the silicon oxide is abraded to polish the substrate.

20. The method of claim 19, wherein the substrate further comprises silicon nitride, and wherein at least a portion of the silicon nitride is abraded to polish the substrate.

21. The method of claim 19, wherein the substrate further comprises polysilicon, and wherein at least a portion of the polysilicon is abraded to polish the substrate.