## Summary

The present disclosure demonstrates that increasing the acidity in the backbone of a fluoropolymer can improve the fluoropolymer's performance as a polymer processing additive, for example, during the extrusion of a non-fluorinated, thermoplastic polymer. The acidity in the backbone can be evaluated by the mole percent of diad units -$CF_2$–CF(R)-CH(R')-CF(R")- in the fluoropolymer.

Thus, the present disclosure provides a polymer composition that includes a non-fluorinated, thermoplastic host polymer a minor amount of a fluoropolymer that is combined with the non-fluorinated, thermoplastic host polymer. The fluoropolymer includes diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent, wherein R is -$CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

In one aspect, the present disclosure provides a polymer composition comprising: a non-fluorinated, thermoplastic polymer; and a minor amount of a fluoropolymer combined with the non-fluorinated, thermoplastic polymer, the fluoropolymer comprising diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent, wherein R is -$CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

The present disclosure also provides a polymer processing additive composition that includes a fluoropolymer and a polymer processing additive synergist. The fluoropolymer includes diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent, wherein R is -$CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

In another aspect, the present disclosure provides a polymer processing additive composition comprising: a fluoropolymer comprising diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent, wherein R is -$CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups; and a polymer processing additive synergist.

The present disclosure also provides a method of reducing melt defects during the extrusion of a polymer. The method includes combining a non-fluorinated, thermoplastic host polymer and a fluoropolymer to form an extrudable composition and extruding the extrudable composition. In another aspect, the present disclosure provides a method of reducing melt defects during the extrusion of a polymer, the method comprising extruding the polymer composition of the present disclosure. The fluoropolymer includes diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent, wherein R is -$CF_3$, -Rf, or –ORf, R' and R"

are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

The present disclosure also provides the use of a fluoropolymer including diads represented by formula -$CF_2$–CF(R)-CH(R')-CF(R")- in a range from about 23 mole percent to about 50 mole percent as a polymer processing additive. In the dyads, R is -$CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

In this application:

Terms such as "a", "an" and "the" are not intended to refer to only a singular entity, but include the general class of which a specific example may be used for illustration. The terms "a", "an", and "the" are used interchangeably with the term "at least one".

What is claimed is:

1. A polymer composition comprising:

a non-fluorinated, thermoplastic polymer; and

a minor amount of a fluoropolymer combined with the non-fluorinated, thermoplastic polymer, the fluoropolymer comprising diads represented by formula $-CF_2-CF(R)-CH(R')-CF(R")-$ in a range from about 23 mole percent to about 50 mole percent, wherein R is $-CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups.

2. The polymer composition of claim 1, wherein the fluoropolymer comprises copolymerized hexafluoropropylene units and vinylidene fluoride units.

3. The polymer composition of claim 2, wherein the hexafluoropropylene units are present in a range from about 23 mole percent to about 50 mole percent, and wherein the vinylidene fluoride units are present in a range from about 50 mole percent to about 77 mole percent.

4. The polymer composition of claim 1, wherein the fluoropolymer is a terpolymer comprising copolymerized hexafluoropropylene units, vinylidene fluoride units, and tetrafluoroethylene units.

5. The polymer composition of claim 4, wherein the hexafluoropropylene units are present in a range from about 23 mole percent to about 50 mole percent, and wherein the vinylidene fluoride units are present in an amount of at least about 23 mole percent.

6. The polymer composition of claim 4 or 5, wherein the tetrafluoroethylene units are present in an amount up to about 27 mole percent.

7. The polymer composition of any one of claims 1 to 6, wherein the fluoropolymer has a Mooney viscosity ML 1+10 @ 121°C in a range from 30 to 90.

8. The polymer composition of any one of claims 1 to 7, further comprising at least one polymer processing additive synergist.

9. The polymer composition of claim 8, wherein the polymer processing additive synergist comprises at least one of a poly(oxyalkylene) polymer, a silicone-polyether copolymer, an aliphatic polyester, a polytetrafluoroethylene, or an aromatic polyester.

10. The polymer composition of claim 9, wherein the polymer processing additive synergist comprises at least one of a poly(oxyalkylene) or a polycaprolactone.

11. The polymer composition of any one of claims 1 to 10, wherein the non-fluorinated, thermoplastic polymer comprises at least one of a polyolefin, polyamide, polyimide, polyurethane, polyester, polycarbonate, polyketone, polyurea, polystyrene, polyvinyl chloride, polyacrylate, or polymethacrylate.

12. The polymer composition of claim 11, wherein the non-fluorinated, themoplastic polymer comprises at least one polyolefin.

13. The polymer composition of claim 12, wherein the polyolefin is a homogeneously catalyzed polyolefin.

14. The polymer composition of any one of claims 1 to 13, wherein R is $CF_3$.

15. The polymer composition of any one of claims 1 to 14, wherein R' is H, and wherein R" is F.

16. A method of reducing melt defects during the extrusion of a polymer, the method comprising extruding the polymer composition of any one of claims 1 to 15.

17. A polymer processing additive composition comprising:

a fluoropolymer comprising diads represented by formula $-CF_2–CF(R)-CH(R')-CF(R")-$ in a range from about 23 mole percent to about 50 mole percent, wherein R is $-CF_3$, -Rf, or –ORf, R' and R" are independently H, F, $CF_3$, or –Rf, and wherein Rf is a perfluoroalkyl group having from 1 to 12 carbon atoms and optionally interrupted by one or more -O- groups; and

a polymer processing additive synergist.

18. The polymer processing additive composition of claim 17, wherein the polymer processing additive synergist comprises at least one of a poly(oxyalkylene) polymer, a silicone-polyether copolymer, an aliphatic polyester, a polytetrafluoroethylene, or an aromatic polyester.

19. The polymer processing additive composition of claim 17 or 18, wherein the polymer processing additive synergist comprises at least one of a poly(oxyalkylene) or a polycaprolactone.

20. The polymer processing additive composition of any one of claims 17 to 19, wherein R is $CF_3$, wherein R' is H, and wherein R" is F