Alternatively, solvent-based polymer systems, particularly for alkyd coating and urethane coating compositions, do not require such a heat-cure step after application. However, alkyd and urethane coatings produced using solvent-based polymer systems have a tendency to be non-uniform and uneven after drying (air-cure), have low oil-contact angles, and poor cleanability ratings. Attempts have been made to overcome the problem of lack of evenness/uniformity, and to increase the cleanability and oil- and water-repellency of these types of coatings by the addition of a variety of surfactants and other compounds.

The present invention addresses the issues described above by introducing compositions comprised of solvent-based fluoroalkyl (meth)acrylate copolymers with short perfluoroalkyl groups of 6 or less carbons. They are utilized as coating additives and impart unexpectedly desirable surface effects such as: uniform spreading, increased water and oil contact angles, enhanced cleanability to the coated film and air-cured coated surface.

SUMMARY ~~OF THE INVENTION~~

The present ~~invention~~disclosure provides a fluoropolymer composition that is useful as a coating additive comprising a fluoropolymer and a solvent, wherein the fluoropolymer comprises repeating units in any sequence of the following:

I: $[R_f—X—Y—C(O)—CZ—CH_2]_a$ —

II: $[R_f—X—Y—C(O)—CH\text{-}CH_2]_b$ —

III: $[CCl_2—CH_2]_c$ —

IV: $[R^1—O—C(O)—C(CH_3)—CH_2]_d$ —

V: $[R^1—O—C(O)—CH—CH_2]_e$ —

VI: $[R^2—Y—C(O)—CT\text{-}CH_2]_g$

wherein

q is 0 to about 40; and

provided that

1) repeating unit I, $[R_f—X—Y—C(O)—CZ—CH_2]_a$ — , is present in the fluoropolymer at a minimum of about 30% by weight of the fluoropolymer,

2) repeating units I, II and III, $[R_f—X—Y—C(O)—CZ—CH_2]_a$— , $[R_f—X—Y—C(O)—CH\text{-}CH_2]_b$— and $[CCl_2—CH_2]_c$— are present at a minimum combined total of about 50% by weight of the fluoropolymer; and

3) the total of all repeating units, I – VI plus any optional monomers equals 100% by weight of the fluoropolymer.

In one aspect of the present disclosure, there is provided a coating composition comprising a fluoropolymer composition and a coating base, wherein the fluoropolymer composition comprises a fluoropolymer and an organic solvent and further wherein the fluoropolymer comprises repeating units in any sequence of polymer units:

I: $[R_f—X—Y—C(O)—CZ—CH_2]_a$ —

II: $[R_f—X—Y—C(O)—CH\text{-}CH_2]_b$ —

III: $[CCl_2—CH_2]_c$ —

IV: $[R^1—O—C(O)—C(CH_3)—CH_2]_d$ —

V: $[R^1—O—C(O)—CH—CH_2]_e$ —

VI: $[R^2—Y—C(O)—CT\text{-}CH_2]_g$

wherein

R_f is a straight or branched perfluoroalkyl group having 2-6 carbon atoms which is optionally interrupted by at least one oxygen atom;

X is an organic divalent linking group having from 1 to 20 carbon atoms selected from straight chain, branched chain or cyclic structures of alkylene, arylene, aralkylene, sulfonyl, sulfoxy, sulfonamido, carbonamido, carbonyloxy, urethanylene, ureylene, or combinations thereof, and optionally containing a triazole, oxygen, nitrogen, or sulfur, or a combination thereof;

Y is O, S or N(R) wherein R is H or C_1 to C_{20} alkyl;

Z is a straight or branched alkyl group having from 1 to 4 carbon atoms, or halide;

R^1 is a straight or branched alkyl group having from 12 to 22 carbon atoms;

a is a positive integer;

b is a zero or positive integer;

c is a positive integer;

d is a positive integer;

e is a zero or positive integer;

g is zero or a positive integer;

T is H, a straight, branched or cyclic alkyl group having from about 1 to about 10 carbon atoms, or halide;

R^2 is H, C_nH_{2n+1}, C_nH_{2n-1}, C_mH_{2m}—CH(O)CH_2, $[CH_2CH_2O]_pR^3$, $[CH_2CH(CH_3)O]_pR^3$, $[C_mH_{2m}]N(R^3)_2$;

n is from 8 to 40;

m is 1 to 40;

each R^3 is independently H, CH_2OH or C_gH_{2g+1};

p is 1 to 200;

g is 0 to 40; and

provided that

1) repeating unit I, $[R_f—X—Y—C(O)—CZ—CH_2]_a$— , is present in the fluoropolymer at a minimum of 30% by weight of the fluoropolymer,

2) repeating units I, II and III, $[R_f—X—Y—C(O)—CZ—CH_2]_a$— , $[R_f—X—Y—C(O)—CH\text{-}CH_2]_b$— and $[CCl_2—CH_2]_c$— are present at a minimum combined total of 50% by weight of the fluoropolymer; and

3) the total of all repeating units, I – VI plus any optional monomers equals 100% by weight of the fluoropolymer.

In another aspect, there is provided a method for treating a substrate with a coating composition comprising contacting the substrate with the coating composition as defined above and drying or curing the coating composition on the substrate.

In still another aspect, there is provided a coated substrate wherein the substrate comprises a dried coating produced from a coating composition as defined above.

DETAILED DESCRIPTION

All trademarks are denoted herein by capitalization. In all instances herein, the term "(meth)acrylate" is used to denote either or both acrylate or methacrylate.

The present invention provides a fluoropolymer composition comprising a fluoropolymer and a solvent wherein the fluoropolymer is a fluoroalkyl (meth)acrylate copolymer. The fluoropolymer comprises repeating units I – VI as set forth herein, in any sequence. The fluoropolymer may be a random copolymer, statistical copolymer, block copolymer, multiblock copolymer, gradient copolymer, or alternating copolymer. The fluoropolymer comprises repeating units in any sequence of the following:

I: $[R_f—X—Y—C(O)—CZ—CH_2]_a$ —

II: $[R_f—X—Y—C(O)—CH\text{-}CH_2]_b$ —

III: $[CCl_2—CH_2]_c$ —

IV: $[R^1—O—C(O)—C(CH_3)—CH_2]_d$ —

V: $[R^1—O—C(O)—CH—CH_2]_e$ —