

In this formula, Rf represents a fluoroalkyl group having from 1 to 6 carbon atoms optionally interrupted by one -O- group, or Rf represents a polyfluoropolyether group. R^1 is hydrogen or methyl. Q is a bond, $-SO_2-N(R)-$, or $-C(O)-N(R)-$, wherein R is alkyl having from 1 to 4 carbon atoms or hydrogen, and m is an integer from 0 to 11. The copolymer is a thermoplastic copolymer or is not covalently crosslinked.

In another aspect, the present disclosure provides a composition comprising a fluoropolymer and the copolymer in any of its embodiments described above or below.

In another aspect, the present disclosure provides a method of making a composition. The method includes blending the copolymer in any of its embodiments described above or below with a fluoropolymer to make the composition.

In another aspect, the present disclosure provides a method of making a film. The method includes providing the composition in any of its embodiments and extruding the composition into a film.

As described above, compositions including the fluoropolymers and copolymers typically provide protection to ultraviolet light and have good transparency to visible and infrared light. Accordingly, the present disclosure provides a photovoltaic device include the composition according to the present disclosure in any of its embodiments.

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".

The phrase "comprises at least one of" followed by a list refers to comprising any one of the items in the list and any combination of two or more items in the list. The phrase "at least one of" followed by a list refers to any one of the items in the list or any combination of two or more items in the list.

The term “ultraviolet absorbing group” refers to a covalently attached ultraviolet absorber (UVA). UVAs are known to those skilled in the art as being capable of dissipating absorbed light energy from UV rays as heat by reversible intramolecular proton transfer. UVAs are selected such that the copolymer in any of the embodiments of copolymers or second copolymers disclosed herein absorbs at least 70%, 80%, or 90% of incident light in a wavelength range from 180 nanometers (nm) to 400 nm.

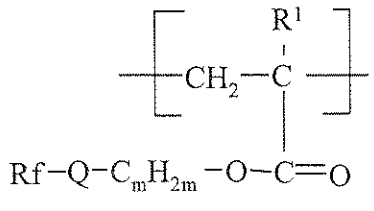
"Alkyl group" and the prefix "alk-" are inclusive of both straight chain and branched chain groups and of cyclic groups. Unless otherwise specified, alkyl groups herein have up to 20 carbon atoms.

What is claimed is:

1. A copolymer comprising:

a first divalent unit comprising a pendent ultraviolet absorbing group; and

a second divalent unit represented by formula:



;

wherein

Rf represents a fluoroalkyl group having from 1 to 6 carbon atoms optionally interrupted by one -O- group, or Rf represents a polyfluoropolyether group;

R^1 is hydrogen or methyl;

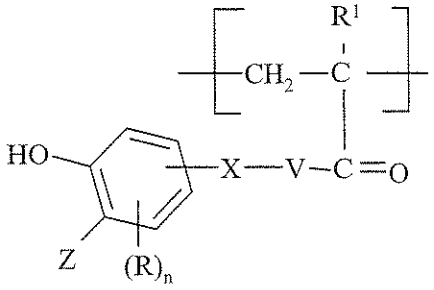
Q is a bond, $-SO_2-N(R)-$, or $-C(O)-N(R)-$, wherein R is alkyl having from 1 to 4 carbon atoms or hydrogen; and

m is an integer from 0 to 11,

wherein the copolymer is ~~a thermoplastic copolymer~~not covalently crosslinked.

2. The copolymer of claim 1, wherein the pendent ultraviolet absorbing group comprises a triazine, a benzophenone, or a benzotriazole.

3. The copolymer of claim 2, wherein the first divalent unit is represented by formula:



,

wherein

R^1 is hydrogen or methyl;

V is O or NH;

X is alkylene or alkyleneoxy group having from 1 to 10 carbon atoms and optionally interrupted by one or more –O- groups and optionally substituted by a hydroxyl group;

R is alkyl having from one to four carbon atoms;

n is 0 or 1; and