HARDCOAT COMPOSITION AND COATED ARTICLE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to U.S. Provisional Application No. 61/614,297, filed March 22, 2012, the disclosure of which is incorporated by reference in its entirety herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with government support under contract number DE-FC36-08GO18027 awarded by the Department of Energy. The Government has certain rights in this invention.

BACKGROUND

Polymeric films and other substrates are useful in a wide variety of indoor and outdoor applications. It is often desirable that polymeric films and substrates have a surface finish that is devoid of ripples, scratches, and other imperfections. However, polymeric surfaces may tend to be somewhat soft and easily scratched or marred. Blown or otherwise contacting abrasive particles can scratch an unprotected polymeric surface, and contact cleaning operations also can similarly mar an unprotected polymeric surface. To overcome these tendencies, protective coatings are sometimes used on polymeric films and substrates. Ultra-violet light and other radiation curable acrylic coating compositions can be applied to some polymeric surfaces and cured to provide a protective coating, sometimes referred to as a hardcoat.

SUMMARY

The present disclosure provides coating compositions that may be applied to polymeric surfaces. The resulting coatings typically adhere well to polymeric substrates even after exposure to accelerated weathering, which can make them useful, for example, in the field of solar energy conversion. The coating compositions typically provide coatings that are more abrasion-resistant than the polymeric substrates themselves, as determined by haze measurement after a falling sand abrasion evaluation. In some embodiments, the coated articles disclosed herein are readily cleanable and/or resist the accumulation of dust.

~~In one aspect, t~~The present disclosure provides a coating composition. The coating composition includes a poly(methyl methacrylate) polymer or copolymer, monomer, and a stabilizer against ultraviolet light. The poly(methyl methacrylate) polymer or copolymer has a weight average molecular weight of at least 50,000 grams per mole. The monomer, which may be a single monomer or a mixture of monomers, includes at least one of an alkylene diacrylate, alkylene dimethacrylate, cycloalkylene diacrylate, or cycloalkylenedimethacrylate. The alkylene diacrylate, alkylene dimethacrylate, cycloalkylene diacrylate, and/or cycloalkylenedimethacrylate provides at least 80 percent by weight of the monomer. In a first aspect, the present disclosure provides a coating composition comprising: a

poly(methyl methacrylate) polymer or copolymer having a weight average molecular weight of at least 50,000 grams per mole; monomer comprising at least one of an alkylene diacrylate, alkylene dimethacrylate, cycloalkylene diacrylate, or cycloalkylenedimethacrylate, wherein the at least one of an alkylene diacrylate, alkylene dimethacrylate, cycloalkylene diacrylate, or cycloalkylenedimethacrylate provides at least 80 percent by weight of the monomer; and a stabilizer against ultraviolet light, wherein the stabilizer comprises at least one of a UV absorber or a hindered amine light stabilizer.

~~In another aspect, t~~The present disclosure also provides an article including a substrate and a first coating on a surface of the substrate. The first coating is obtained by curing the coating composition disclosed herein. In another aspect, the present disclosure provides an article comprising a polymeric substrate and a first coating on a surface of the polymeric substrate, wherein the first coating is obtained by curing the coating composition as defined herein. In some embodiments, the article further includes a second coating disposed on the first coating. In some of these embodiments, the second coating includes silica particles having an average particle size of up to 500 nanometers.

~~In another aspect, t~~The present disclosure also provides a method of making an article. The method includes contacting a surface of a substrate with the coating composition disclosed herein; removing organic solvent, if present, from the coating composition; and exposing the coating composition to actinic radiation to provide a first coating on the surface of the polymeric substrate. Typically, in this method, the coating composition includes a photoinitiator.

In some embodiments, of the foregoing aspects of the article or method of making the article, the substrate is a polymeric substrate. In some embodiments, the substrate is a thermoplastic substrate. In some of these embodiments, the substrate includes an acrylic, a polyester, a polycarbonate, a blend of PVDF and PMMA, or a combination thereof.

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 phrases "at least one of" and "comprises at least one of" followed by a list refers to any one of the items in the list and any combination of two or more items in the list. All numerical ranges are inclusive of their endpoints and non-integral values between the endpoints unless otherwise stated.

"Alkyl group", "alkylene", and the prefix "alk-" are inclusive of both straight chain and branched chain groups. "Alkylene" is the divalent form of "alkyl". Unless otherwise specified, alkyl or alkylene groups herein have up to 20 carbon atoms. Cycloalkyl and cycloalkylene groups can be monocyclic or polycyclic and, unless otherwise specified, have from 3 to 10 ring carbon atoms. Alkyl, alkylene, cycloalkyl, and cycloalkylene groups contain only carbon and hydrogen atoms.

The term "solvent" refers to a homogeneous liquid material, which may be a single compound or a combination of compounds and which may or may not include water, that is capable of at least partially dissolving the coating composition disclosed herein at 25 °C.

The term "polymer" refers to a molecule having a structure which includes the multiple repetition of units derived, actually or conceptually, from molecules of low relative molecular mass.

The term "monomer" refers to a molecule of low relative molecular mass that can combine with others to form a polymer, which may be an acrylic polymer or copolymer.

The term "acrylic" refers acrylic and methacrylic polymers, which may be copolymers made from one or more acrylates or methacrylates or other vinyl-containing monomers.

The above summary of the present disclosure is not intended to describe each disclosed embodiment or every implementation of the present disclosure. The description that follows more particularly exemplifies illustrative embodiments. It is to be understood, therefore, that the drawings and