According to a first aspect, there is provided a hard coat comprising a nanoparticle mixture and a binder; the nanoparticles constituting from 40 to 95 mass% of an entire mass of the hard coat; from 10 to 50 mass% of the nanoparticles having an average particle size within a range of 2 to 200 nm; from 50 to 90 mass% of the nanoparticles having an average particle size within a range of 60 to 400 nm; a ratio of the average particle size of nanoparticles having an average particle size within the range of 60 to 400 nm to the average particle size of nanoparticles having an average particle size within the range of 2 to 200 nm being within a range of 2: 1 to 200: 1; a particle size distribution of the nanoparticles being bimodal or multimodal; the binder comprising a polyfunctional fluorinated (meth)acrylic compound, a reaction product thereof, or a combination thereof; wherein the polyfunctional fluorinated (meth)acrylic compound comprises cyclic siloxane units.

Another embodiment of the present disclosure provides a hard coat precursor including a nanoparticle mixture and a binder, the nanoparticles constituting from 40 to 95 mass% of a total mass of the nanoparticles and the binder; from 10 to 50 mass% of the nanoparticles having an average particle size within the range of 2 to 200 nm; from 50 to 90 mass% of the nanoparticles having an average particle size within the range of 60 to 400 nm; the ratio of the average particle size of nanoparticles having an average particle size within the range of 60 to 400 nm to the average particle size of nanoparticles having an average particle size within the range of 2 to 200 nm being within the range of 2: 1 to 200: 1 ; and the binder including a polyfunctional fluorinated (meth)acrylic compound.

According to a second aspect, there is provided a hard coat precursor comprising a nanoparticle mixture and a binder; the nanoparticles constituting from 40 to 95 mass% of a total mass of the nanoparticles and the binder; from 10 to 50 mass% of the nanoparticles having an average particle size within a range of 2 to 200 nm; from 50 to 90 mass% of the nanoparticles having an average particle size within a range of 60 to 400 nm; a ratio of the average particle size of nanoparticles having an average particle size within the range of 60 to 400 nm to the average particle size of nanoparticles having an average particle size within the range of 2 to 200 nm being within a range of 2: 1 to 200: 1 ; wherein a particle size distribution of the nanoparticles is bimodal or multimodal; and the binder comprising a polyfunctional fluorinated (meth)acrylic compound; wherein the polyfunctional fluorinated (meth)acrylic compound comprises cyclic siloxane units.

The anti-smudge hard coat of the present disclosure filled with a high concentration of nanoparticles demonstrates both excellent scratch resistance and impact resistance while maintaining optical transparency. Additionally, since the binder contains a polyfunctional fluorinated (meth)acrylic compound, a reaction product thereof, or a combination thereof, it is possible to prevent the adhesion of fingerprints, grease, dust, smudges, and the like or to easily wash the hard coat in the event of such adhesion, and it is also possible to increase the durability of the anti-smudge properties. In addition, such an anti-smudge hard coat can be formed using the anti-smudge hard coat precursor of the present disclosure.

The above description should not be considered a disclosure of all of the embodiments of the present invention or all of the advantages of the present invention.

Brief Description of the Drawings

FIG. 1 is a graph showing the results of simulations between the mass ratios and filling rates of a small particle group and a large particle group for combinations of several particle sizes (small particle group/large particle group).

FIG. 2 is a pattern diagram of an abrasion resistance test device used in the embodiments.

Detailed Description

The present invention will be described in further detail hereinafter with the purpose of illustrating representative embodiments of the present invention, however, the present invention is not limited to these embodiments.

In the present disclosure, "(meth)acrylic" refers to "acrylic or methacrylic", and "(meth)acrylate" refers to "acrylate or methacrylate".

The hard coat of one embodiment of the present disclosure contains a nanoparticle mixture and a binder, and the binder contains a polyfunctional fluorinated (meth)acrylic compound, a reaction product thereof, or a combination thereof.

Examples of representative binders contained in the hard coat include resins obtained by polymerizing a curable monomer and/or a curable oligomer and resins obtained by polymerizing sol-gel glass. More specific examples include acrylic resins, urethane resins, epoxy resins, phenol resins, and polyvinyl alcohol resins. Further, the curable monomer or curable oligomer can be selected from