According to a first aspect, there is provided a hard coat comprising a nanoparticle mixture and a binder; the nanoparticles constituting from ~~40~~ 60 to ~~95~~ 90 mass% of an entire mass of the hard coat; from 10 to 50 mass% of the nanoparticles having an average particle size "A" within a range of 2 to ~~200~~ 150 nm; from 50 to 90 mass% of the nanoparticles having an average particle size "B" within a range of ~~60~~ 70 to ~~400~~ 300 nm; a ratio of the average particle size "B" ~~of nanoparticles having an average particle size within the range of 60 to 400 nm~~ to the average particle size "A" ~~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~~ 60 to ~~95~~ 90 mass% of a total mass of the nanoparticles and the binder; from 10 to 50 mass% of the nanoparticles having an average particle size "A" within a range of 2 to ~~200~~ 150 nm; from 50 to 90 mass% of the nanoparticles having an average particle size "B" within a range of ~~60~~ 70 to ~~400~~ 300 nm; a ratio of the average particle size "B" ~~of nanoparticles having an average particle size within the range of 60 to 400 nm~~ to the average particle size "A" ~~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.

What is Claimed is:

1. A hard coat comprising a nanoparticle mixture and a binder;

the nanoparticles constituting from ~~40~~ 60 to ~~90~~95 mass% of an entire mass of the hard coat;

from 10 to 50 mass% of the nanoparticles having an average particle size "A" within a range of 2 to ~~200~~ 150 nm;

from 50 to 90 mass% of the nanoparticles having an average particle size "B" within a range of ~~60~~ 70 to 300~~400~~ nm;

a ratio of the average particle size "B" ~~of nanoparticles having an average particle size within the range of 60 to 400 nm~~ to the average particle size "A" ~~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.

2. The hard coat according to claim 1, wherein the nanoparticles are surface-modified nanoparticles.

3. The hard coat according to claim 1 or 2, wherein the polyfunctional fluorinated (meth)acrylic compound is a perfluoroether compound having two or more (meth)acrylic groups.

4. The hard coat according to one of claims 1 to 3, wherein the polyfunctional fluorinated (meth)acrylic compound has 3 or more (meth)acrylic groups.

5. The hard coat according to one of claims 1 to 4, wherein the nanoparticles are inorganic oxide nanoparticles, and the polyfunctional fluorinated (meth)acrylic compound comprises siloxane units.

6. The hard coat according to claim 5, wherein the nanoparticles are silica nanoparticles.

7. The hard coat according to one of claims 1 to 6, wherein the binder further comprises an ultraviolet absorbent.

8. A hard coat precursor comprising a nanoparticle mixture and a binder;
the nanoparticles constituting from 60~~40~~ to 90~~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 "A" within a

range of 2 to ~~200~~ 150 nm;

from 50 to 90 mass% of the nanoparticles having an average particle size "B" within a range of 70~~60~~ to 300~~400~~ nm;

a ratio of the average particle size "B" ~~of nanoparticles having an average particle size within the range of 60 to 400 nm~~ to the average particle size "A" ~~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.