MULTI-FUNCTIONAL COMPOSITIONS AND METHODS OF USE

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to U.S. Provisional Application Serial No. 61/696005, filed on August 31, 2012, which is incorporated herein by reference in its entirety.

BACKGROUND

The invention is directed to removing unwanted constituents from a siliceous surfaces and determining the cleanliness of a siliceous surface.

Conventional window cleaning compositions are typically designed to leave no visible residue on a glass surface when used to clean the glass surface. In other words, the glass surface should be free from a film and streaking. To achieve these properties, the level of surfactant and other additives in the cleaning composition must be low.

Organic solvents are often present in conventional window cleaning compositions to enable the composition to remove common stains and oily contaminants from glass surfaces.

Some window cleaning compositions include hydrophilic polymers or long chain alkyl sulfate surfactants, which are alleged to impart water-sheeting and anti-spotting properties to a surface cleaned therewith. Such compositions tend to leave behind a hydrophilic residue, which contributes to the water-sheeting effect and helps to remove soil from the glass surface.

Compositions that include silanes have been used to impart a hydrophilic property to a glass surface that has been cleaned and activated. The preference for some of these compositions is for the surface be activated immediately prior to, or simultaneously with, the application of the aqueous composition. Such compositions, however, typically require the surface to be pre-cleaned.

Coating compositions that include silanes have also been used to coat glass substrates to render them capable of being easily cleaned.

SUMMARY

The present ~~invention~~ disclosure is directed to multi-functional compositions and the use thereof. Such compositions have multiple functions, e.g., cleaning and protecting.

In one aspect, the ~~invention~~ disclosure features a method of removing an unwanted constituent from a siliceous surface, the method including contacting the siliceous surface and the unwanted constituent with a multi-functional ~~solution~~ composition that includes water, a hydrophilic silane, and a surfactant, and drying the surface. In one embodiment, the method further includes rubbing the solution on the surface.

In one embodiment, the solution imparts a hydrophilic property to the surface and the dried surface exhibits a greater hydrophilicity relative to the hydrophilicity of the surface prior to the contacting.

In one embodiment, the siliceous surface is a surface of a board selected from the group consisting of a white board and a dry erase board, and the unwanted constituent includes a mark from a marker. In some embodiments, the siliceous surface is a surface of glass, such as a window or door, and the unwanted constituent includes at least one of oil and dirt.

The siliceous surface can include glass shower doors, tile walls, porcelain bathtubs, sinks, or other surfaces on which soap scum accumulates.

In some embodiments, the dried surface exhibits sufficient hydrophilicity such that at least 50 % of a mark placed on the surface with a permanent marker is wiped away from the surface within 50 wipes with a damp towel. In other embodiments, the dried surface exhibits sufficient hydrophilicity such that at least 50 % of a mark placed on the surface with a permanent marker is washed away from the surface within 2 minutes by a spray of water applied at a rate of 600 milliliters per minute. In some embodiments, the dried surface exhibits sufficient hydrophilicity such that a fingerprint of artificial sebum placed on the dried surface is washed away from the surface within 2 minutes by a spray of water applied at a rate of 600 milliliters per minute. In other embodiments, when the dried surface is contacted with moisture vapor, no condensation occurs.

~~In other aspects, t~~The ~~invention~~ disclosure may also features a method of removing an unwanted constituent (e.g., one or more of the components of soap scum) from a siliceous surface, the method including contacting the siliceous surface and the unwanted constituent with a multi-functional composition that includes water, a hydrophilic silane, surfactant, and at least one of water soluble alkali metal silicate, a polyalkoxy silane (such as a tetraalkoxysilane (e.g., TEOS), or a tetraalkoxysilane oligomer),and an inorganic silica sol, and drying the surface.

In another aspect, a method of cleaning and protecting a siliceous surface is provided. The method includes: applying an aqueous composition to the surface, the composition comprising: a hydrophilic silane; a surfactant; and water; wherein the ratio of the total weight of the surfactants to the total weight of the hydrophilic silane is at least 1:2; and rubbing the composition onto the surface to clean the surface (e.g., remove soap scum) and protect the surface (e.g., from the build-up of soap scum).

The disclosure may also ~~In some aspects, the invention~~ features a method of determining the cleanliness of a previously cleaned substrate (e.g., one cleaned by a method of the present disclosure or cleaned with a composition of the present disclosure), the method including exposing the previously cleaned surface, which is at a temperature of from 0°C to about 25°C, to moisture vapor, observing whether or not condensation occurs, and if fogging is present, determining that the surface is dirty, and if fogging does not occur or is not present more than 30 seconds after exposure to the moisture vapor, determining that the surface is clean.

The disclosure may also ~~In another aspect, the invention~~ features a method of determining the cleanliness of a previously cleaned substrate (e.g., one cleaned by a method of the present disclosure or cleaned with a composition of the present disclosure), the method including placing a mark with a permanent marker on the previously cleaned surface of the substrate, saturating the mark with water, wiping the mark with a paper towel, and determining whether or not at least 90 % of the mark has been washed away by the spray of

water, and if at least 90 % of the mark has been washed away by the spray of water, then determining that the surface is clean. In some embodiments, the method further includes determining that the surface is not clean if at least 50 % of the mark has not been washed away by the spray of water.

The disclosure may also ~~In other aspects, the invention~~ features a method of determining the cleanliness of a previously cleaned substrate (e.g., one cleaned by a method of the present disclosure or cleaned with a composition of the present disclosure), the method including placing a fingerprint of artificial sebum on the previously cleaned surface of the substrate, spraying the fingerprint and the substrate with a stream of deionized water at a flow rate of no greater than 600 milliliters per min for no greater than 30 seconds, and determining whether or not at least 50 % of the fingerprint has been washed away by the spray of water, if at least 50 % of the fingerprint has been washed away by the spray of water, then determining that the surface is clean, and if at least 50 % of the fingerprint has not been washed away by the spray of water, then determining that the surface is not clean.

In another aspect, there is provided a liquid multi-functional aqueous composition comprising: a hydrophilic silane; a surfactant; at least one of a water soluble alkali metal silicate, a polyalkoxy silane, and an inorganic silica sol; and water.

The disclosure may also ~~In other aspects the invention~~ features a multi-functional solution that includes a first hydrophilic silane, surfactant, the ratio of the weight of the hydrophilic silane to the weight of the surfactant being at least 1:1, and water. In one embodiment, the solution further includes at least one of a water soluble alkali metal silicate and a polyalkoxy silane (such as a tetraalkoxysilane (e.g., TEOS), or a tetraalkoxysilane oligomer). In some embodiments, the solution further includes a second surfactant different from the first surfactant. In one embodiment, the solution further includes a second hydrophilic silane different from the first hydrophilic silane.

In another embodiment, the solution includes a water soluble alkali metal silicate comprising at least one of lithium silicate, sodium silicate, and potassium silicate.

In some embodiments, the solution passes Permanent Marker Removal Test Method I. In other embodiments, the solution passes Artificial Sebum Removal Test Method I. In some embodiments, the solution passes the Fog Test Method.

In another embodiment, the solution includes from at least 0.01 % by weight to no greater than 3 % by weight hydrophilic silane. In some embodiments, the solution includes no greater than 0.5 % by weight hydrophilic silane. In other embodiments, the solution includes no greater than 2 % by weight solids. In one embodiment, the solution includes no greater than 1 % by weight solids.

In some embodiments, the hydrophilic silane includes a zwitterionic silane. In other embodiments, the solution includes from about 0.01 % by weight to about 5 % by weight zwitterionic silane. In another embodiment, the solution includes from about 0.1 % by weight to about 2 % by weight zwitterionic silane.

In some embodiments, the surfactant includes at least one of anionic surfactant, nonionic surfactant, cationic surfactant, amphoteric betaine surfactant, amphoteric sultaine surfactant, amphoteric imidazoline surfactant, amine oxide surfactant, and quaternary cationic surfactant. In other embodiments, the first surfactant includes a nonionic surfactant and the second surfactant includes an anionic surfactant.

In some embodiments, the hydrophilic silane has a molecular weight up to 5000 grams per mole, or up to 3000 grams per mole. In some embodiments, the hydrophilic silane has a molecular weight no greater than 1000 grams per mole. In another embodiment, the hydrophilic silane has a molecular weight no greater than 500 grams per mole.

In one embodiment, the solution includes at least 60 % by weight water. This is typically for a ready-to-use formulation. In other embodiments, the composition includes no greater than 30 % by weight water. This is typically for a concentrated formulation.

In one aspect, there is provided a multi-functional aqueous composition comprising: a hydrophilic silane; at least two different surfactants; and water.

The disclosure may also ~~In another aspect, the invention~~ features a liquid multi-functional composition that includes a hydrophilic silane, a first surfactant, at least one of a water soluble alkali metal silicate and a polyalkoxy silane (such as a tetraalkoxysilane (e.g., TEOS), or a tetraalkoxysilane oligomer), and an inorganic silica sol, and water. In one embodiment, the hydrophilic silane includes a zwitterionic hydrophilic silane. In some embodiments, the hydrophilic silane is selected from the group consisting of zwitterionic silane, hydroxyl sulfonate silane, phosphonate silane, carboxylate silane, glucanamide silane, polyhydroxyl alkyl silane, hydroxyl polyethyleneoxide silanes, polyethyleneoxide silanes, and combinations thereof. In some embodiments, the composition passes Permanent Marker Removal Test Method I. In other embodiments, the composition passes Artificial Sebum Removal Test Method I. In another embodiment, the composition passes the Fog Test Method.

In other embodiments, the composition further includes water insoluble particles. In one embodiment, the composition further includes abrasive particles.

In some embodiments, the composition further includes a second surfactant different from the first surfactant.

The disclosure may also ~~In other aspects, the invention~~ features a multi-functional liquid composition that includes a hydrophilic silane, a first surfactant, a second surfactant different from the first surfactant, and water. In one embodiment, the hydrophilic silane is selected from the group consisting of zwitterionic silane, hydroxyl sulfonate silane, phosphonate silane, carboxylate silane, glucanamide silane, polyhydroxyl alkyl silane, hydroxyl polyethyleneoxide silane, polyethyleneoxide silane, and combinations thereof. In another embodiment, the composition passes Permanent Marker Removal Test Method I. In some embodiments, the composition passes Artificial Sebum Removal Test Method I. In other embodiments, the composition passes the Fog Test Method. In some embodiments, the composition further includes water insoluble particles. In one embodiment, the composition further includes abrasive particles.

The disclosure may also ~~In other aspects the invention~~ features a method of using a multi-functional solution, the method includes diluting a concentrated solution with water to form a diluted solution, the concentrated solution comprising a first hydrophilic silane and surfactant where the ratio of the weight of the hydrophilic silane to the weight of the surfactant is at least 1:1, and contacting a siliceous surface with the diluted solution.