Description

Title: Compositions Comprising Fatty Acid Chloride And/Or Alkyl Ketene Dimer

FIELD OF THE INVENTION

The present invention relates to a coating material comprising a fatty acid chloride, an alkyl ketene dimer and a metal oxide. The present invention also relates to a coating composition comprising a fatty acid chloride, an alkyl ketene dimer, a metal oxide, and a solvent, a method of preparing the coating composition, a method of coating a substrate, use of the coating material or the composition to coat a substrate, a method of softening a textile or fabric comprising the step of contacting a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, with the textile or fabric, and the use of a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, as a textile softener or a fabric softener.

BACKGROUND OF THE INVENTION

Hydrophobic surfaces have extremely high repellency or extremely low affinity for water. Hydrophobicity of a material is determined by the contact angle of a water droplet on the surface. Generally Hydrophobic surface is understood as a surface that has a water droplet contact angle higher than 90°. Most superhydrophobic coatings made by currently available technologies are not durable. The coatings do not have good adhesion to the substrate, so they are easily scratched off, the coating deteriorates over time, and are often made from non-renewable resources.

Further, it is well known that textiles, particularly those made of cellulose fibers after washing becomes hard and coarse and unpleasant to the touch after drying. This undesired hardness generally can be overcome by treating the fabric after washing by rinsing with liquid dispersions of cationic compounds, such as a cationic fabric softening agent dispersed in water. Fabric softener or conditioning compositions are commonly used to impart a fabric softening effect onto a fabric. However after washing, the fabric softening effect is lost and the fabric again becomes unpleasant to touch after drying, making it necessary to use a fabric softener every time after washing.

Many fabric softeners comprise quaternary ammonium compounds, or “quats”. Quats need to be readded after every time a fabric is washed, as it is typically lost from the fabric surface during the washing process due to loose, electrostatic bonding onto the fabric as well as due to interaction with anionic washing detergents during the washing process. Although quats are known to improve the softness and wearability of clothes right out of the wash, some are known to trigger asthma and may be toxic to the reproductive system.

There is therefore a pressing need to develop a composition, that overcomes or at least ameliorates, one or more of the disadvantages described above. Specifically, there is a need for a composition which imparts durable hydrophobicity and/or fabric softening effects to a substrate.

SUMMARY

In an aspect, there is provided a coating material comprising a fatty acid chloride, an alkyl ketene dimer and a metal oxide.

Advantageously, the coating material may be used as a hydrophobic coating for maintenance, enhancement and protection of various substrates from water, to prevent oxidation of surfaces in air and moisture, especially for cellulosic materials such as wood, leather, cotton textiles, fabric, filters, membranes, and paint, where hydrophobic surfaces are particularly desired.

Advantageously, the coating material may have water repellent, self-cleaning, corrosion resistant, and/or antibacterial properties.

Advantageously, the coating may be strongly bonded to the surface of a substrate, rather than simply physically adsorbed onto the surface of the substrate by electrostatic interactions, thereby extending the durability of the hydrophobic effect. The strong bonding may be facilitated by the long fatty acid/ester groups of the components of the coating material, i.e. the fatty acid chloride and alkyl ketene dimer, with the surface.

Advantageously, the use of a combination of the fatty acid chloride, alkyl ketene dimer and metal oxide may prevent the degradation of the substrate such as wood, leather, textile or fabric. Degradation of the substrate may occur if only one of fatty acid chloride or alkyl ketene dimer is used to coat the substrate. However, by using a combination of the fatty acid chloride, alkyl ketene dimer and metal oxide, this may be prevented.

Advantageously, the metal oxide may facilitate the coating process and provide the substrate with UV-protection.

In another aspect, there is provided a coating composition comprising a fatty acid chloride, an alkyl ketene dimer, a metal oxide, and a solvent.

In another aspect, there is provided a method of preparing the coating composition as defined above, comprising the step of contacting a fatty acid chloride, an alkyl ketene dimer and a metal oxide with a solvent.

In another aspect, there is a method of coating a substrate comprising the step of applying the coating material as defined above or the coating composition as defined above onto the substrate.

In another aspect, there is provided the use of the coating material as defined above or the coating composition as defined above to coat a substrate.

In another aspect, there is provided a method of softening a textile or fabric, the method comprising the step of contacting a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, with the textile or fabric.

In another aspect, there is provided the use of a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, as a textile softener or a fabric softener.

Advantageously, relatively low concentrations (less than 10% w/v) of fatty acid chloride, alkyl ketene dimer or a mixture thereof may have textile or fabric softening properties and may act as an alternative to ammonium-based fabric softeners. Advantageously, fatty acid chloride, alkyl ketene dimer or a mixture thereof may have long-lasting textile or fabric softening effects compared to conventional textile or fabric softeners.

Advantageously, the fatty acid chloride, alkyl ketene dimer or a mixture thereof may strongly bind to the textile or fabric, rather than being simply physically adsorbed onto the surface of the textile or fabric by electrostatic interactions. The strong bonding may extend the durability of the softening effect of the fabric or textile. The strong bonding may be facilitated by the long fatty acid/ester groups of the composition, i.e. the fatty acid chloride or alkyl ketene dimer, with the surface. Advantageously, the long fatty acid/ester groups may strongly attach to the surface of the fabric or textile, which may impart lubricity to the fabric or textile by lining up with the fibres. This may be different to the mechanism of conventional fabric softeners which may act by neutralizing the negative charge on the surface of the fabric or the textile.

DEFINITIONS

The following words and terms used herein shall have the meaning indicated:

"Alkyl" as a group or part of a group refers to a straight or branched aliphatic hydrocarbon group. The group may be a terminal group or a bridging group.

The word “softening” in the context of this application refers to coating of the surface of a textile or fabric with chemical compounds, to impart a softer and fluffier texture to the textile or fabric. The term “softener” should be construed accordingly.

The word “substantially” does not exclude “completely” e.g. a composition which is “substantially free” from Y may be completely free from Y. Where necessary, the word “substantially” may be omitted from the definition of the invention.

Unless specified otherwise, the terms "comprising" and "comprise", and grammatical variants thereof, are intended to represent "open" or "inclusive" language such that they include recited elements but also permit inclusion of additional, unrecited elements.

As used herein, the term "about", in the context of concentrations of components of the formulations, typically means +/- 5% of the stated value, more typically +/- 4% of the stated value, more typically +/- 3% of the stated value, more typically, +/- 2% of the stated value, even more typically +/- 1% of the stated value, and even more typically +/- 0.5% of the stated value.

Throughout this disclosure, certain embodiments may be disclosed in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the disclosed ranges. Accordingly, the description of a range should be considered to have specifically disclosed all the possible sub-ranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed sub-ranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 3, 4, 5, and 6. This applies regardless of the breadth of the range.

Certain embodiments may also be described broadly and generically herein. Each of the narrower species and subgeneric groupings falling within the generic disclosure also form part of the disclosure. This includes the generic description of the embodiments with a proviso or negative limitation removing any subject matter from the genus, regardless of whether or not the excised material is specifically recited herein.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1

[Fig. 1] refers to a graph showing the contact angle of a 100% cotton cloth that has been coated with the inventive coating after multiple washes without detergent.

Fig. 2

[Fig. 2] refers to a graph showing the contact angle of a 100% cotton cloth that has been coated with the inventive coating after multiple washes with detergent.

Fig. 3

[Fig. 3] refers to a set of photographic images showing a water droplet placed on top of a 100% cotton cloth that has been coated with the inventive coating. [Fig. 3A] shows the cotton cloth coated with the inventive coating before washing, [Fig. 3B] shows the cotton cloth coated with the inventive coating after one wash and [Fig. 3C] shows the cotton cloth coated with the inventive coating after four washes.

Fig. 4

[Fig. 4] refers to a photographic images showing water droplets placed on Jute coated with the inventive coating

DETAILED DESCRIPTION OF OPTIONAL EMBODIMENTS

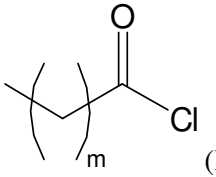
There is provided a coating material comprising a fatty acid chloride, an alkyl ketene dimer and a metal oxide.

The metal oxide may be titanium dioxide or silicon dioxide.

The number of carbons in the fatty acid chloride may be in the range of 2 to 60, 2 to 4, 2 to 8, 2 to 16, 2 to 30, 4 to 8, 4 to 16, 4 to 30, 4 to 60, 8 to 16, 8 to 30, 8 to 60, 16 to 30, 16 to 60 or 30 to 60.

The fatty acid chloride may comprise an aliphatic fatty acid chloride or an aromatic fatty acid chloride.

The fatty acid chloride may have the following formula (I):



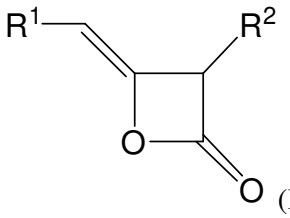
(I),

wherein m is an integer from 1 to 20.

m may be an integer from 1 to 5, 1 to 10, 1 to 15, 1 to 20, 5 to 10, 5 to 15, 5 to 20, 10 to 15, 10 to 20 or 15 to 20. m may be 14.

The fatty acid chloride may be selected from the group consisting of palmitoyl chloride, stearic acid chloride, lauryl acid chloride and any mixture thereof.

The alkyl ketene dimer may have the following formula (II):



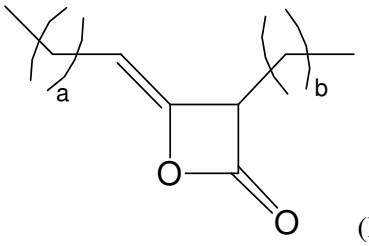
(II),

wherein R^1 and R^2 are independently an optionally substituted alkyl.

The optionally substituted alkyl may be substituted or unsubstituted.

The optionally substituted alkyl may be a C_1 to C_{20} alkyl, C_1 to C_5 alkyl, C_1 to C_{10} alkyl, C_1 to C_{15} alkyl, C_5 to C_{10} alkyl, C_5 to C_{15} alkyl, C_5 to C_{20} alkyl, C_{10} to C_{15} alkyl, C_{10} to C_{20} alkyl or C_{15} to C_{20} alkyl.

The alkyl ketene dimer may have the following formula (III):



(III),

wherein a and b are each independently an integer from 1 to 20.

a and b may each independently be an integer from 1 to 5, 1 to 10, 1 to 15, 1 to 20, 5 to 10, 5 to 15, 5 to 20, 10 to 15, 10 to 20 or 15 to 20.

a and b may independently be 16 or18.

In the alkyl ketene dimer, the proportion of the functional groups (or a or b as defined above) having a chain length of C18 may be in the range of about 30% to about 95%, about 30% to about 45%, about 30% to about 60%, about 30% to about 75%, about 45% to about 60%, about 45% to about 75%, about 45% to about 95%, about 60% to about 75%, about 60% to about 95% or about 75% to about 95%, based on the total number of functional groups.

The alkyl ketene dimer may be alkyl ketene dimer 1895, alkyl ketene dimer 1865, alkyl ketene dimer 1875, or alkyl ketene dimer 1840.

The coating material may further comprise an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof.

The coating material may further comprise a solvent.

The solvent may be an organic solvent or an aqueous solvent. The organic solvent may be chloroform, dichloromethane, hexane, ether, petroleum oil, kerosene, methanol, ethanol, butanol, octanol and any mixture thereof The aqueous solvent may be water. The water may be tap water.

There is also provided a coating composition comprising a fatty acid chloride, an alkyl ketene dimer, a metal oxide, and a solvent.

The fatty acid chloride or the alkyl ketene dimer may each be present at a range of about 0.001% w/v to about 10% w/v of the solvent.

The fatty acid chloride or the alkyl ketene dimer may each be present at a range of about 0.001% w/v to about 10% w/v, about 0.001% w/v to about 0.01% w/v, about 0.001% w/v to about 0.1% w/v, about 0.001% w/v to about 1% w/v, about 0.01% w/v to about 0.1% w/v, about 0.01% w/v to about 1% w/v, about 0.01% w/v to about 10% w/v, about 0.1% w/v to about 1% w/v, about 0.1% w/v to about 10% w/v, or about 1% w/v to about 10% w/v of the solvent.

The metal oxide may be present at a range of about 0.01% w/v to about 0.15% w/v of the solvent.

The metal oxide may be present at a range of about 0.01% w/v to about 0.15% w/v, about 0.01% w/v to about 0.05% w/v, about 0.01% w/v to about 0.1% w/v, about 0.05% w/v to about 0.1% w/v, about 0.05% to about 0.15% w/v, or about 0.1% w/v to about 0.15% w/v of the solvent.

There is also provided a method of preparing the coating composition as defined above, comprising the step of contacting a fatty acid chloride, an alkyl ketene dimer and a metal oxide with a solvent.

The method may further comprise the step of adding an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof. The additive may be added at an amount of about 0.001% w/v to about 1% w/v, about 0.001% w/v to about 0.01% w/v, about 0.001% w/v to about 0.1% w/v, about 0.01% w/v to about 0.1% w/v, about 0.01% w/v to about 1% w/v, or about 0.1% w/v to about 1% w/v.

The method may comprise the step of removing the solvent to obtain the coating material as defined above.

The step of removing the solvent may comprise drying. The drying may be by heating. The drying may be performed at room temperature or at a temperature in the range of about 100 °C to about 115 °C, about 100 °C to about 105 °C, about 100 °C to about 110 °C, about 105 °C to about 100 °C, about 105 °C to about 115 °C, or about 110 °C to about 115 °C. The heating may facilitate the formation of the bond between the coating material and a substrate, as well as the drying of the coating material.

There is also provided a method of coating a substrate comprising the step of applying the coating material as defined above or the coating composition as defined above onto the substrate.

The applying step may comprise dipping the substrate in the coating composition.

The dipping step may be performed for a duration in the range of about0.001 seconds to about 10 hours, about 0.001 seconds to about 1 second, about 0.001 seconds to about 1 minute, about 0.001 seconds to about 1 hour, about 1 second to about 1 minute, about 1 second to about 1 hour, about 1 second to about 10 hours, about 1 minute to about 1 hour, about 1 minute to about 10 hours, or about 1 hour to about 10 hours.

The method may further comprise the step of heating the coating material. The heating may be performed at a temperature in the range of about 60 °C to about 120 °C, about 60 °C to about 80 °C, about 60 °C to about 100 °C, about 80 °C to about 100 °C, about 80 °C to about 120 °C, or about 100 °C to about 120 °C.

The heating step may activate the coating material to bind with the substrate. By heating the coating material, the coating material may bind to the surface of the substrate by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces..

There is also provided the use of the coating material as defined above or the coating composition as defined above to coat a substrate.

The coating material may be strongly bonded onto the substrate by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces.

The coating material may confer hydrophobicity to the substrate.

The substrate may comprise hydroxy or amine functional groups on the surface.

The substrate may be wood, leather, Jute fiber, textile, fabric, or any mixture thereof.

The leather may be natural, synthetic or a combination thereof. The fabric or textile may be natural, synthetic or a combination thereof.

The textile or fabric may be woven, knitted or a combination thereof.

The textile or fabric may comprise cellulose, chiffon, cotton, crepe, nylon, silk, polyester, rayon, wool, flax fibre, linen, pile, imitation fur, velvet or any mixture thereof.

The textile or fabric may comprise cellulose fibres.

The textile or fabric may comprise cellulose or cotton.

The fatty acid chloride or the alkyl ketene dimer may each be present at a range of about 0.001% w/v to about 3% w/v in the coating.

There is also provided a method of softening a textile or fabric, the method comprising the step of contacting a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, with the textile or fabric.

The contacting step may comprise dipping the textile or fabric in the composition comprising the fatty acid chloride, alkyl ketene dimer or a mixture thereof and the solvent

The fatty acid chloride or the alkyl ketene dimer may each be present at a range of about 0.001% w/v to about 0.5% w/v of the solvent.

The fatty acid chloride or the alkyl ketene dimer may each be present at a range of about 0.001% w/v to about 0.5% w/v, about 0.001% w/v to about 0.005% w/v, about 0.001% w/v to about 0.01% w/v, about 0.01% w/v to about 0.05% w/v, about 0.001% w/v to about 0.1% w/v, about 0.005% w/v to about 0.01% w/v, about 0.005% w/v to about 0.05% w/v, about 0.005% w/v to about 0.1% w/v, about 0.005% w/v to about 0.5% w/v, about 0.01% w/v to about 0.05% w/v, about 0.01% w/v to about 0.1% w/v, about 0.01% w/v to about 0.5% w/v, about 0.05% w/v to about 0.1% w/v, about 0.05% w/v to about 0.5% w/v or about 0.1% w/v to about 0.5% w/v of the solvent.

The method may further comprise the step of adding a metal oxide to the composition, prior to contacting with the textile or fabric.

The metal oxide may be present at a range of about 0.01% w/v to about 0.15% w/v of the solvent.

The method may further comprise adding an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof to the composition, prior to contacting with the textile or fabric.

The dipping step may be performed for a duration in the range of about0.001 seconds to about 10 hours, about 0.001 seconds to about 1 second, about 0.001 seconds to about 1 minute, about 0.001 seconds to about 1 hour, about 1 second to about 1 minute, about 1 second to about 1 hour, about 1 second to about 10 hours, about 1 minute to about 1 hour, about 1 minute to about 10 hours, or about 1 hour to about 10 hours.

The method may further comprise the step of heating the composition. The heating may be performed at a temperature in the range of about 60 °C to about 120 °C, about 60 °C to about 80 °C, about 60 °C to about 100 °C, about 80 °C to about 100 °C, about 80 °C to about 120 °C, or about 100 °C to about 120 °C.

The heating step may activate the coating material to bind with the substrate. By heating the coating material, the coating material may bind to the surface of the substrate by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces.

The heating step may facilitate the formation of the bond between the coating material and the substrate, as well as the drying of the coating material.

Use of a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, as a textile softener or a fabric softener.

The fatty acid chloride, the alkyl ketene dimer or a mixture thereof may be strongly bonded to the textile or fabric by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces.

The fabric or textile may be natural, synthetic or a combination thereof.

The textile or fabric may be woven, knitted or a combination thereof.

The textile or fabric may comprise cellulose, chiffon, cotton, crepe, nylon, silk, polyester, rayon, wool, flax fibre, linen, pile, imitation fur, velvet or any mixture thereof.

The textile or fabric may comprise cellulose fibres.

The textile or fabric may comprise cellulose or cotton.

One skilled in the art readily understands that the different examples of the disclosure may have applications in environments where optimization of a composition with fatty acid chloride, alkyl ketene dimer and/or metal oxide is desired. Therefore, the present disclosure is not limited solely to the above-presented examples, but can be modified within the scope of the disclosure.

EXAMPLES

Non-limiting examples of the invention will be further described in greater detail by reference to specific Examples, which should not be construed as in any way limiting the scope of the invention.

Methods

Example 1: Hydrophobic coating A

A fatty acid chloride solution was prepared by adding 18 g of palmitoyl chloride (Wilmar (China) Oleo Co., Ltd, China) in 300 ml of dichloromethane (DCM) (Sigma-Aldrich, St. Louis, Missouri, USA). Then, a cotton cloth (3 inch by 2 inch) (purchased from a market) was immersed in the solution for 3 minutes. After that, the cotton cloth was taken out and washed with DCM four times, to remove any unbounded palmitoyl chloride from the treated cloth. The cloth was dried at 80 °C for 10 minutes under normal air.

A few drops of water was placed on the surface of the treated cloth, which showed excellent hydrophobic character.

Durability of the hydrophobic properties was tested after repeated washing using detergent water. Washing was performed with normal tap water and detergent (Procter &Gamble, Cincinnati, Ohio, USA). Specifically, 2.0 gm of P&G dynamo detergent was dissolved in one liter of water. Each wash cycle was performed for 20 minutes at 180 rpm using a tergotometer (Copley Scientific, Nottingham, UK), followed by drying the cloth in an oven at 80 °C for 10 minutes under normal air

It was found that even after 6 washes, the contact angle remained above 140°. The fact that hydrophobicity was observed even after 6 washes showed that the bond between the coating and the cotton cloth was strong.

Example 2: Hydrophobic coating B

The same procedures as Example 1 was repeated but with 9 g palmitoyl chloride instead of 18 g of palmitoyl chloride.

In a similar manner to Example 1, excellent hydrophobic character was observed and it was found that even after 6 washes, the contact angle remained above 140°.

Example 3: Hydrophobic coating C

A fatty acid chloride (palmitoyl chloride) solution was prepared by adding 9 g of palmitoyl chloride in 300 ml of dichloromethane (DCM) in a similar manner to Example 2. In that solution, 0.27 g TiO_2 nanoparticles (Sigma-Aldrich, St. Lous, Missouri, USA) having an average particle size of less than 100 nm, was added. Then, a 100% cotton cloth (3 inch by 2 inch) was immersed in the solution for 3 minutes**.** After that, the

cotton cloth was taken out and washed with DCM 4 times, to remove any unbounded palmitoyl chloride from the treated cloth. The cloth was dried at 80 °C for 10 minutes under normal air.

In a similar manner to Example 1, excellent hydrophobic character was observed and it was found that even after 6 washes, the contact angle remained above 140°.

Example 4: Hydrophobic coating D

An alkyl ketene dimer solution was prepared by adding 18 g of alkyl ketene dimer 1895 (Wilmar, Singapore) in 300 ml of dichloromethane (DCM) (Sigma-Aldrich, St. Louis, Missouri, USA). Then, a 100% cotton cloth (3 inch by 2 inch) (purchased from a market) was immersed in the solution for 3 minutes. After that, the cotton cloth was dried at 80 °C for 10 minutes under normal air, and after that was taken out and washed with DCM 4 times, to remove any unbounded alkyl ketene dimer from the treated cloth. The cloth was dried again at 80 °C for 10 minutes under normal air.

In a similar manner to Example 1, excellent hydrophobic character was observed and it was found that even after 6 washes, the contact angle remained above 140°. The fact that hydrophobicity was observed even after 6 washes showed that the bond between the coating and the cotton cloth was strong.

Example 5: Hydrophobic coating E

The same procedures as Example 4 was repeated but with 9 g alkyl ketene dimer 1895 instead of 18 g of alkyl ketene dimer 1895.

In a similar manner to Example 1, excellent hydrophobic character was observed and it was found that even after 6 washes, the contact angle remained above 140°.

Example 6: Hydrophobic coating F

An alkyl ketene dimer solution was prepared by adding 9 g of alkyl ketene dimer 1895 in 300 ml of dichloromethane (DCM) in a similar manner to Example 5. In that solution, 0.27 g TiO_2 nanoparticles (Sigma-Aldrich, St. Lous, Missouri, USA) having an average particle size of less than 100 nm, was added. Then, a 100% cotton cloth (3 inch by 2 inch) (purchased from a market) was immersed in the solution for 3 minutes. After that, the cotton cloth was dried at 80 °C for 10 minutes under normal air, and after that, the cotton cloth was taken out and washed with DCM 4 times, to remove any unbounded alkyl ketene dimer from the treated cloth. The cotton cloth was dried again at 80 °C for 10 minutes under normal air.

In a similar manner to Example 1, excellent hydrophobic character was observed, and it was found that even after 6 washes, the contact angle remained above 140°.

Example 7: Hydrophobic coating G

An alternative example of the coating was prepared by dissolving 3 g of alkyl ketene dimer 1895 in 100 mL of dichloromethane (DCM). Then, a 100% cotton cloth (3 inch by 2 inch) or Jute was dipped into the solution for 3 minutes and taken out to be dried, by keeping it at 80 °C for 10 minutes.

The contact angle of the cloth was found to be about 150 °. A water drop placed on the cloth was stable and was not absorbed into the cloth even after 1 hour.

Durability of the hydrophobic properties was tested after repeated washing.

Washing was firstly performed with normal tap water without any detergent. Each wash cycle was performed for 20 minutes at 180 rpm using a tergotometer, followed by drying the cloth in an oven at 80 °C for 10 minutes under normal air. The contact angle was measured after each wash, as shown in Fig. 1.

Washing was then performed with normal tap water and detergent (P&G). Specifically, 2.0 gm of P&G dynamo detergent was dissolved in one liter of water. Each wash cycle was performed for 20 minutes at 180 rpm using a tergotometer, followed by drying the cloth in an oven at 80 °C for 10 minutes under normal air. The contact angle was measured after each wash, as shown in Fig. 2.

The stability of water droplet on the cloth before washing, after 1 wash and after 4 washes was also visually observed, as shown in Fig. 3.

Similar hydrophobicity was observed on Jute coated with the coating as described above, as shown in Fig. 4.

Example 8: Fabric Softener A

A fatty acid chloride solution was prepared by adding 3 g of palmitoyl chloride (Wilmar (China) Oleo Co., Ltd, China) in 300 ml of dichloromethane (DCM) (Sigma-Aldrich, St. Louis, Missouri, USA). Then, a 100% cotton cloth (3 inch by 2 inch) (purchased from a market) was immersed in the solution for 3 minutes. After that, the cotton cloth was taken out and washed with DCM 4 times, to remove any unbounded palmitoyl chloride from the treated cloth. The cloth was dried at 80 °C for 10 minutes under normal air.

It was found that the surface of the treated cotton was very pleasant to touch, even after several washings with DCM. The fact that pleasant touch was observed even after several washes showed that the bond between the softener and the cotton cloth was strong.

Example 9: Fabric Softener B

An alkyl ketene dimer solution was prepared by adding 3 g of alkyl ketene dimer 1895 (Wilmar, Singapore) in 300 ml of dichloromethane (DCM) (Sigma-Aldrich, St. Louis, Missouri). Then, a 100% cotton cloth (3 inch by 2 inch) (purchased from a market) was immersed in the solution for 3 minutes. After that, the cloth was dried at 80 °C for 10 minutes under normal air. After that, the cotton cloth was taken out and washed with DCM 4 times, to remove any unbounded alkyl ketene dimer from the treated cloth. After that, the cloth was dried at 80 °C for 10 minutes under normal air.

In a similar manner to Example 8, it was found that the surface of the treated cotton was very pleasant to touch, even after several washings.

Example 10: Fabric Softener C (Sample-1)

An alkyl ketene dimer emulsion was prepared by adding 6 g of alkyl ketene dimer 1895 (Wilmar, Singapore) in 100 ml of tap water to form an aqueous emulsion solution and was denoted Sample-1. Sample-1 and its diluents were tested for fabric softness and smoothness after application on 100% cotton woven fabric (white) (3 inch by 2 inch) after prewashing with AATCC Standard Reference detergent powder (without optical brightener).

The cotton woven fabric was immersed in Sample-1 and its diluents as outlined in Table 1 for less than 1 minute at room temperature, and excess solution was removed by padding.

An M:L ratio (ratio of mass (in grams) of fabric : volume (in mL) of sample solution) of 1:30 was used. That is, for 1 gram of fabric, 30 mL of sample solution. For example, if the weight of an A4 sized fabric was 10 grams, then it was treated with 300 mL of sample solution at a particular concentration. The fabric used was 100% Cotton woven fabric (RFD) having a weight of approximately 155 grams per square meter. RFD stands for Ready for Dyeing (bleach unfinished cloth).

The treated cotton woven fabric was then dried at 105 °C to 108 °C for 3 minutes using hot air.

Table 1. Testing of Sample-1

Sample name	dilution
Inventive example	
Sample -1	Alkyl ketene dimer aqueous emulsion (6% alkyl ketene dimer 1895)
Sample-A	Sample -1 diluted with water at 1:1 by volume
Sample-B	Sample -1 diluted with water at 1:5 by volume
Sample-C	Sample -1 diluted with water at 1:11 by volume)
Sample-D	Sample -1 diluted with water at 1:23 by volume
Sample-E	Sample -1 diluted with water at 1:33 by volume
Reference Samples (commercially available Catamine OC)	
Sample-F	0.5 % (v/v) Catamine OC aqueous solution pH 5.0-6.0 (Chromolin Capital Chemicals Pvt. Ltd., Navi Mumbai, Maharashtra, India)
Sample-G	2% (v/v) Catamine OC aqueous solution pH 5.0-6.0
Sample-H	3 % (v/v) Catamine OC aqueous solution pH 5.0-6.0

5 panelists were selected at random to evaluate the dried fabric for softness and/or smoothness by relative hand feel in a blind test. The results were as follows:

Panelist No.1: $H \geq E > D \geq G > F > C > B > A$

Panelist No.2: $H \geq E = D \geq G > F > C > B > A$

Panelist No.3: $H \geq E > D \geq G > F > C > B > A$

Panelist No.4: $H = E \geq D > G > F > C > B > A$

Panelist No.5: $H = E = D = G > F > C > B > A$

As shown above, Samples H and E were evaluated to have the most softness and/or smoothness, while Sample A was evaluated to have the least softness and/or smoothness.

Sample E containing alkyl ketene dimer 1895 (effectively 0.18% of active ingredient, alkyl ketene dimer) imparted an equivalent level of softness as compared to Sample H which contained 3% of the Reference Sample (Catamine-OC). This shows that Sample-E required almost 15-fold less of the active ingredient by weight than the Reference Sample to impart a fabric softening effect.

INDUSTRIAL APPLICABILITY

The coating material and the coating composition as defined above may be used to impart hydrophobicity to a substrate such as wood, leather, textile, fabric and any mixture thereof. Further, a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, may be useful as a textile softener or a fabric softener.

It will be apparent that various other modifications and adaptations of the invention will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the invention and it is intended that all such modifications and adaptations come within the scope of the appended claims.

CLAIMS

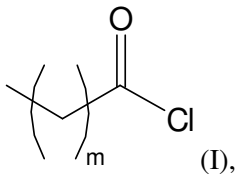
1. A coating material comprising a fatty acid chloride, an alkyl ketene dimer and a metal oxide.

2. The coating material according to claim 1, wherein the metal oxide is titanium dioxide.

3. The coating material according to claim 1 or 2, wherein the number of carbons in the fatty acid chloride is in the range of 2 to 60.

4. The coating material according to any one of the preceding claims, wherein the fatty acid chloride comprises an aliphatic fatty acid chloride or an aromatic fatty acid chloride.

5. The coating material according to any one of the preceding claims, wherein the fatty acid chloride has the following formula (I):

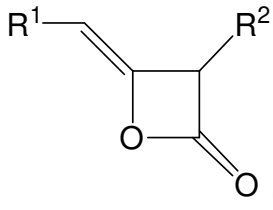


(I),

wherein m is an integer from 1 to 20.

6. The coating material according to claim 5, wherein the fatty acid chloride is palmitoyl chloride.

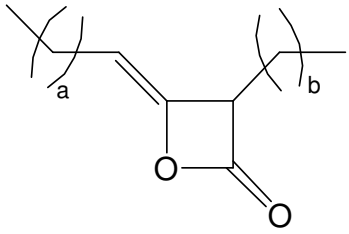
7. The coating material according to any one of the preceding claims, wherein the alkyl ketene dimer has the following formula (II):



(II),

wherein R^1 and R^2 are independently an optionally substituted alkyl.

8. The coating material according to claim 7, wherein the alkyl ketene dimer has the following formula (III):



(III),

wherein a and b are each independently an integer from 1 to 20.

9. The coating material according to any one of the preceding claims, wherein the alkyl ketene dimer is alkyl ketene dimer 1895.

10. The coating material according to any one of the preceding claims, further comprising an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof.

11. The coating material according to any one of the preceding claims, further comprising a solvent.

12. The coating material according to claim 11, wherein the solvent is an organic solvent or an aqueous solvent.

13. A coating composition comprising a fatty acid chloride, an alkyl ketene dimer, a metal oxide, and a solvent.

14. The coating composition according to claim 13, wherein the fatty acid chloride or the alkyl ketene dimer is each present at a range of about 0.001% w/v to about 10% w/v of the solvent, and the metal oxide is present at a range of about 0.01% w/v to about 0.15% w/v of the solvent.

15. A method of preparing the coating composition according to any one of claims 13 to 14, comprising the step of contacting a fatty acid chloride, an alkyl ketene dimer and a metal oxide with a solvent.

16. The method according to claim 15, further comprising the step of adding an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof.

17. The method according to any one of claims 15 to 16, comprising the step of removing the solvent to obtain the coating material of any one of claims 1 to 12.

18. A method of coating a substrate comprising the step of applying the coating material according to any one of claims 1 to 12 or the coating composition according to any one of claims 13 to 14 onto the substrate.

19. Use of the coating material of any one of claims 1 to 12 or the coating composition according to any one of claims 13 to 14 to coat a substrate.

20. The method according to claim 18 or the use according to claim 19, wherein the coating material is bonded onto the substrate by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces.

21. The method or use according to claim 20, wherein the coating material confers hydrophobicity to the substrate.

22. The method or use according to claim 21, wherein the substrate is wood, leather, Jute fiber, textile, fabric, or any mixture thereof.

23. The method or use according to claim 22, wherein the textile or fabric comprises cellulose or cotton.

24. A method of softening a textile or fabric, the method comprising the step of contacting a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, with the textile or fabric.

25. The method according to claim 24, wherein the fatty acid chloride or the alkyl ketene dimer is each present at a range of about 0.001% w/v to about 10% w/v of the solvent.

26. The method according to claim 24 or 25, further comprising the step of adding a metal oxide to the composition, prior to contacting with the textile or fabric.

27. The method according to claim 26, wherein the metal oxide is present at a range of about 0.01% w/v to about 0.15% w/v of the solvent.

28. The method according to any one of claims 24 to 27, further comprising the step of adding an additive selected from the group consisting of an anti-UV agent, anti-bacterial agent, anti-fungal agent, anti-oxidant agent, fragrance and any mixture thereof to the composition, prior to contacting with the textile or fabric.

29. Use of a composition comprising fatty acid chloride, an alkyl ketene dimer or a mixture thereof and a solvent, as a textile softener or a fabric softener.

30. The method according to any one of claims 24 to 28 or use according to claim 29, wherein the fatty acid chloride, the alkyl ketene dimer or a mixture thereof is bonded to the textile or fabric by covalent bonding, ionic bonding, hydrogen bonding, Van der Waals forces, Keesom forces, or London dispersion forces.

31. The method or use according to claim 30, wherein the textile or fabric comprises cellulose or cotton.