gravure, flexo-graphic, curtain, drip, roller, screen printing coating methods, extrusion coating and slit coating, but are not limited to these.

It is also an aim of the present disclosure to provide material compositions that are capable of producing optically good quality films even on structured (textured) glass substrate surfaces.

It is a further aim of the present disclosure to provide a computer or personal communication device, comprising a central processing unit (CPU) and a display wherein the display comprises an array of optical elements; a touch sensor; and a glass cover having a coating that is antireflective and oleophobic hard coating.

In an aspect, there is provided a computer or personal communication device, comprising:

central processing unit (CPU);

wherein the display comprises;

an array of optical elements;

a touch sensor; and

a glass cover having a coating that is oleophobic;

wherein the coating is a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic%

of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating has a water contact angle of 65 or more, an oil contact angle measured with n-hexadecane of 20 degrees or more, and a pencil hardness of 7H or more;

and wherein the coating is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad VII$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad VIII$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad IX$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

It is an aim of the present disclosure to provide a glass substrate having an antireflective and oleophobic hard coating thereon, wherein the coating is a polymer having silicon, oxygen and carbon in the backbone, and wherein the coating has a refractive index of 1.22 to 1.7, a pencil hardness of 6H or more preferably 8H or more, a water contact angle of 65 degrees or more, e.g. 70 degrees or more, and an oil contact angle of 20 degrees or more, e.g. 30 degrees or more.

In another aspect, there is provided a glass substrate having an antireflective and oleophobic coating thereon, wherein the coating is a polymer having silicon, oxygen and carbon in the backbone, and further

comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating has a refractive index of 1.22 to 1.7, a pencil hardness of 7H or more, a water contact angle of 90 degrees or more and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the coating is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad VII$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad VIII$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad IX$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

Thus, the materials combine properties of hydro- and oleophobicity.

In another aspect, there is provided a display with a touch sensitive screen, comprising,

an array of optical elements;

a touch sensor layer;

a cover glass with first optical layer formed thereon;

wherein the first optical layer comprises a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the optical layer has a refractive index of from 1.22 to 1.46, a pencil hardness of 6H or more, a water contact angle of 65 degrees or more, and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the optical layer is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad \text{VII}$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad \text{VIII}$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad \text{IX}$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

It is an aim of the present disclosure to provide a method for making coated glass and coated polymer sheets.

It is an aim of the present disclosure to provide a method of increasing the anti-reflectivity, hardness and oleophobicity of a computer or personal communication device having a touch sensitive screen.

The present disclosure provides material compositions comprising hybrid siloxane polymers.

In another aspect, there is provided a method for making a coated glass, comprising:

providing glass to be coated;

coating the glass with a liquid phase coating;

baking and/or UV hardening the coating on the glass;

wherein the coated glass comprises a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 15 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating on the glass has a refractive index of 1.22 to 1.7, a pencil hardness of 7H or more, a water contact angle of 65 degrees or more, and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the coating is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad VII$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad VIII$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad IX$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

The present disclosure also provides a method, which can be combined with the previous, for making a coated glass, comprising:

- providing glass to be coated;
- coating the glass with a liquid phase coating;
- baking and/or UV hardening the coating on the glass;

wherein the coating to be deposited by liquid phase coating is formed by combining:

- a first monomer having the chemical formula $R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13}$, wherein R^{11} is an alkoxy, acetoxy or chloro group and where x is 2 or 3, and wherein R^{12} is an alkyl group where y is 0 or 1, and wherein R^{13} is an epoxy, acrylate, methacrylate, (substituted) phenyl or isocyanate group;
- a second monomer having the chemical formula $R^{14a}R^{15b}SiC_2H_4(CF)_n$, wherein R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3, and wherein R^{15} is an alkyl group where b is 0 or 1, and wherein n is an integer from 3 to 25; and
- a third monomer having the chemical formula $R^{16c}R^{17d}SiC_2H_4SiR^{18e}R^{19f}$, wherein R^{16} is a an alkoxy, acetoxy or chloro group and wherein c = 2 or 3, wherein R^{17} is an alkyl group or H and wherein d = 0 or 1, wherein R^{18} is an alkoxy, acetoxy or chloro group and wherein e = 2 or 3, and wherein R^{19} is an alkyl group or H and wherein f = 0 or 1.

Formula $R^{16c}R^{17d}SiC_2H_4SiR^{18e}R^{19f}$ represents a subformula for compounds included in general formula VI mentioned above.

The present disclosure provides a method of increasing the anti-reflectivity, hardness and oleophobicity of a display, a computer or personal communication device having a touch sensitive screen, comprising:

- polymerizing a plurality of monomers that comprise silicon, oxygen and carbon so as to form a carbosiloxane polymer with a molecular weight of at least 2000;
- depositing the carbosiloxane polymer with a liquid phase process at atmospheric pressure on a glass substrate;
  wherein after hardening the polymer on the glass substrate, the carbosiloxane polymer has a hardness of at least 6H, a refractive index of from 1.22 to 1.46, and an oil contact angle of at least 30 degrees;
- further providing a central processing unit (CPU), a display, a touch sensor layer, and a housing so as to form a the computer or personal communication device with a touch sensitive screen;

wherein the properties of antireflectivity reduces surface reflection with over 15 %, preferably 20 % or more compared to the same glass substrate without the carbosiloxane polymer layer.

In another aspect, there is provided a method of increasing the hardness and oleophobicity of a computer or personal communication device having a touch sensitive screen, comprising:

polymerizing a plurality of monomers that comprise silicon, oxygen, fluorine and carbon, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, so as to form a carbosiloxane polymer with a molecular weight of at least 2000, wherein the carbosiloxane polymer is obtained by combining a first monomer having the formula

$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13}$ VII

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n$ VIII

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f$ IX

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1;

depositing the carbosiloxane polymer with a liquid phase process at atmospheric pressure on a glass substrate;

wherein after hardening the polymer on the glass substrate, the carbosiloxane polymer has a hardness of at least 7H, a refractive index of from 1.22 to 1.46, a water contact angle of at least 65 degrees, and an oil contact angle of at least 20 degrees;

further providing a CPU, a display, a touch sensor layer, and a housing so as to form a the computer or personal communication device with a touch sensitive screen;

wherein the amount of sunlight reflected from the glass substrate is at least 1.5% less due to the carbosiloxane polymer layer as compared to the same glass substrate without the carbosiloxane polymer layer.

The present disclosure provides computer or personal communication device, comprising a housing; a central processing unit (CPU); and a display; wherein the display comprises; an array of optical elements; a touch sensor; and a glass cover having a coating that is durable antireflective and oleophobic; wherein the coating is a polymer comprising silicon, carbon, oxygen and fluorine, and wherein the atom% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10.

More specifically, the computer device according to the present disclosure is characterized by what is stated in the characterizing part of original claim 1.

The glass substrate having an antireflective and oleophobic hard coating is characterized by what is stated in the charactering part of original claim 10.

The display with a touch sensitive screen is characterized by what is stated in the characterizing part of original claim 22.

The methods for making coated glass is characterized by what is stated in the characterizing parts of original claims 38 and 43.

The method of increasing the hardness and oleophobicity of a computer or personal communication device having a touch sensitive screen is characterized by what is stated in the characterizing part of original claim 53.

The computer or personal communication device, with a display having a glass cover and exhibiting a coating that is antireflective and oleophobic is characterized by what is stated in the characterizing part of original claim 62.

Claims

1. A computer or personal communication device, comprising:
central processing unit (CPU);
wherein the display comprises;
an array of optical elements;
a touch sensor; and
a glass cover having a coating that is oleophobic;
wherein the coating is a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating has a water contact angle of 65 or more, an oil contact angle measured with n-hexadecane of 20 degrees or more, and a pencil hardness of 7H or more;
and wherein the coating is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad \text{VII}$$

wherein
R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,
R^{12} is an alkyl group where y is 0 or 1, and
R^{13} is an epoxy group;
a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad \text{VIII}$$

wherein
R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,
R^{15} is an alkyl group where b is 0 or 1, and
n is an integer from 3 to 25; and
a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad \text{IX}$$

wherein
R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,
R^{17} is an alkyl group or H and d = 0 or 1,
R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and
R^{19} is an alkyl group or H and wherein f = 0 or 1.

2. A glass substrate having an antireflective and oleophobic coating thereon, wherein the coating is a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating has a refractive index of 1.22 to 1.7, a pencil hardness of 7H or more, a water contact angle of 90 degrees or more and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the coating is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad \text{VII}$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad \text{VIII}$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad \text{IX}$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

3. A display with a touch sensitive screen, comprising,

an array of optical elements;

a touch sensor layer;

a cover glass with first optical layer formed thereon;

wherein the first optical layer comprises a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the optical layer has a refractive index of from 1.22 to 1.46, a pencil hardness of 6H or more, a water contact angle of 65 degrees or more, and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the optical layer is deposited by liquid phase coating and is obtained by combining a first monomer having the formula

$$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13} \qquad \text{VII}$$

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n \qquad \text{VIII}$$

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and a third monomer having the formula

$$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f \qquad \text{IX}$$

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

4. A method for making a coated glass, comprising:

providing glass to be coated;

coating the glass with a liquid phase coating;

baking and/or UV hardening the coating on the glass;

wherein the coated glass comprises a polymer having silicon, oxygen and carbon in the backbone, and further comprises fluorine, wherein the atomic% of silicon is from 10 to 15 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, and wherein the coating on the glass has a refractive index of 1.22 to 1.7, a pencil hardness of 7H or more, a water contact angle of 65 degrees or more, and an oil contact angle measured with n-hexadecane of 20 degrees or more;

and wherein the coating is obtained by combining a first monomer having the formula

$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13}$ VII

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n$ VIII

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f$ IX

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1.

5. A method of increasing the hardness and oleophobicity of a computer or personal communication device having a touch sensitive screen, comprising:

polymerizing a plurality of monomers that comprise silicon, oxygen, flourine and carbon, wherein the atomic% of silicon is from 10 to 30, the atomic% of carbon is from 10 to 60, the atomic% of oxygen is from 10 to 60, and the atomic% of fluorine is from 0.1 to 10, so as to form a carbosiloxane polymer with a molecular weight of at least 2000, wherein the carbosiloxane polymer is obtained by combining a first monomer having the formula

$R^{11}{}_xR^{12}{}_ySiC_3H_6R^{13}$ VII

wherein

R^{11} is an alkoxy, acetoxy or chloro group and x is 2 or 3,

R^{12} is an alkyl group where y is 0 or 1, and

R^{13} is an epoxy group;

a second monomer having the formula

$R^{14}{}_aR^{15}{}_bSiC_2H_4(CF)_n$ VIII

wherein

R^{14} is an alkoxy, acetoxy or chloro group and where a is 2 or 3,

R^{15} is an alkyl group where b is 0 or 1, and

n is an integer from 3 to 25; and

a third monomer having the formula

$R^{16}{}_cR^{17}{}_dSiC_2H_4SiR^{18}{}_eR^{19}{}_f$ IX

wherein

R^{16} is a an alkoxy, acetoxy or chloro group and c = 2 or 3,

R^{17} is an alkyl group or H and d = 0 or 1,

R^{18} is an alkoxy, acetoxy or chloro group and e = 2 or 3, and

R^{19} is an alkyl group or H and wherein f = 0 or 1;

depositing the carbosiloxane polymer with a liquid phase process at atmospheric pressure on a glass substrate;

wherein after hardening the polymer on the glass substrate, the carbosiloxane polymer has a hardness of at least 7H, a refractive index of from 1.22 to 1.46, a water contact angle of at least 65 degrees, and an oil contact angle of at least 20 degrees;

further providing a CPU, a display, a touch sensor layer, and a housing so as to form a the computer or personal communication device with a touch sensitive screen;

wherein the amount of sunlight reflected from the glass substrate is at least 1.5% less due to the carbosiloxane polymer layer as compared to the same glass substrate without the carbosiloxane polymer layer.