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(54) **Title:** METHOD FOR FABRICATING HYDROPHOBIC COMPONENT, HYDROPHOBIC COMPONENT AND PHOTO-VOLTAIC DEVICE CROSS-REFERENCE TO RELATED APPLICATIONS

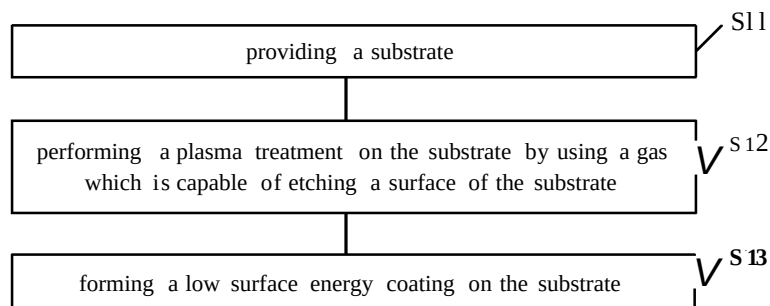


FIG. 1

(57) **Abstract:** A method for fabricating a hydrophobic component, a hydrophobic component and a photovoltaic device are provided. The method includes: providing a substrate (100); performing a plasma treatment on the substrate (100); and forming a low surface energy coating (200) on the substrate (100). The hydrophobic component is fabricated by the method. The photovoltaic device includes: a hydrophobic component fabricated by providing a transparent substrate (100), forming an anti-reflection coating (300) on the transparent substrate (100), performing a plasma treatment on the anti-reflection coating (300), and forming a low surface energy coating (200) on the anti-reflection coating (300); and a solar cell (400) disposed on a side of the transparent substrate (100) which does not have the anti-reflection coating (300) formed thereon. A contact angle of the low surface energy coating (200) may be increased and further the hydrophobicity of the hydrophobic component may be improved.



**METHOD FOR FABRICATING HYDROPHOBIC COMPONENT,
HYDROPHOBIC COMPONENT AND PHOTOVOLTAIC DEVICE**

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to Chinese patent application No. 201310161755.5, filed on May 6, 2013, and entitled "METHOD FOR FABRICATING HYDROPHOBIC COMPONENT, HYDROPHOBIC COMPONENT AND PHOTOVOLTAIC DEVICE", and the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure generally relates to nanophase material technology field, and more particularly, to a method for fabricating a hydrophobic component, a hydrophobic component and a photovoltaic device.

BACKGROUND

[0003] Generally, a contact angle between a hydrophobic solid surface and a droplet thereon is larger than 90°. The contact area between the hydrophobic surface and the droplet is quite small, so the droplet is prone to roll off the hydrophobic surface. As a result, the hydrophobic surface is capable of self-cleaning besides features such as current conduction resistance, anti-corrosion, water proof, anti-fogging, anti-virus, snow defense, frost protection, adhesion resistance, anti-pollution and so on. This, in turn, makes the hydrophobic surface have a broad application prospect in fields such as architecture, clothing and textiles, fluid delivery, biomedicine, commodities and packing, transportation facilities, microanalysis and so on.

[0004] Generally, hydrophobic performance of an object depends on a low surface energy material on its surface.

[0005] In existing techniques, a hydrophobic component generally includes a

substrate and a low surface energy coating formed on a surface of the substrate. The low surface energy coating consists of fluorine-containing siloxane. Thus, a surface of the hydrophobic component has the hydrophobic property due to the low surface energy coating.

[0006] In existing techniques, a contact angle of a low surface energy coating is relatively small, which may lead to a poor hydrophobic performance for the hydrophobic component.

[0007] Further, a photovoltaic device may have a poor hydrophobic performance when the hydrophobic component is applied therein.

[0008] Therefore, there is an urgent need to increase the contact angle of the low surface energy coating to improve the hydrophobicity of the hydrophobic component.

SUMMARY

[0009] An embodiment of the disclosure provides a method for fabricating a hydrophobic component, a hydrophobic component and a photovoltaic device, which may favor an increased contact angle of a low surface energy coating and further boosts hydrophobicity of the hydrophobic component.

[0010] In one aspect, a method for fabricating a hydrophobic component is provided, including: providing a substrate; performing a plasma treatment on the substrate; and forming a low surface energy coating on the substrate.

[0011] A basic principle is to increase a contact angle of the low surface energy coating using the plasma treatment on the substrate before the low surface energy coating is formed, and further improve hydrophobicity of the hydrophobic component.

[0012] In an embodiment, the plasma treatment uses a gas which is capable of etching a surface of the substrate to increase a roughness of the substrate and thus the low surface energy coating can be formed on a rough surface of the substrate, which may in turn improve hydrophobic performance for the low surface energy coating.

[0013] In an embodiment, the plasma treatment uses a gas which is capable of forming hydroxyls on a surface of the substrate, the surface of the substrate thus becomes hydrophilic and the low surface energy coating can be easily combined with the surface of the substrate, which may in turn improve hydrophobic performance for the low surface energy coating.

[0014] In an embodiment, an anti-reflection coating may be formed on the substrate before performing the plasma treatment, so that the hydrophobicity of the hydrophobic component can be improved without influencing anti-reflection capability of the substrate.

[0015] In another aspect, a hydrophobic component fabricated by the above method is provided.

[0016] A basic principle lies in that a hydrophobic component having improved hydrophobic performance can be fabricated by the above method which can improve hydrophobicity of a hydrophobic component.

[0017] In still another aspect, a photovoltaic device is provided, including a hydrophobic component fabricated by the method according to above embodiment, where the substrate is transparent; and a solar cell disposed on a side of the substrate which is opposite to the anti-reflection coating.

[0018] A basic principle lies in that, by fabricating the photovoltaic device based on the above method, the photovoltaic device may have better hydrophobicity and have features of self-cleaning, anti-fingerprint, anti-reflection, anti-fogging and etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 schematically illustrates a flow chart of a method for fabricating a hydrophobic component according to one embodiment of the present disclosure;

[0020] FIG. 2 schematically illustrates a flow chart of a method for forming a low surface energy coating according to one embodiment of the present disclosure;

[0021] FIG. 3 schematically illustrates a flow chart of a method for fabricating a hydrophobic component according to one embodiment of the present disclosure;

[0022] FIG. 4 schematically illustrates a flow chart of a method for fabricating a hydrophobic component according to one embodiment of the present disclosure;

[0023] FIG. 5 schematically illustrates a structure of a hydrophobic component fabricated by above embodiments;

[0024] FIG. 6 schematically illustrates a flow chart of a method for fabricating a hydrophobic component according to one embodiment of the present disclosure;

[0025] FIG. 7 schematically illustrates a structure of the hydrophobic component fabricated by the method shown in FIG. 6;

[0026] FIG. 8 schematically illustrates a diagram of relations between light transmittance of the hydrophobic component, which is fabricated by performing a plasma treatment using Ar in FIG. 7, and wavelength of incident light;

[0027] FIG. 9 schematically illustrates a diagram of relations between light transmittance of the hydrophobic component, which is fabricated by performing a plasma treatment using O_2 in FIG. 7, and wavelength of incident light; and

[0028] FIG. 10 schematically illustrates a structure of a photovoltaic device according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0029] As described in background, in existing techniques, the hydrophobicity of the low surface energy coating needs to be improved.

[0030] In order to clarify the objects, characteristics and advantages of the disclosure, embodiments will be described in following description in conjunction with accompanying figures.

[0031] Based on research, inventor found that, when a low surface energy coating is formed on a substrate with a rough surface or a hydrophilic surface, a contact angle between the low surface energy coating and the substrate may be increased and thus hydrophobicity of the low surface energy coating may be improved. Further, the

inventors found that, if a suitable gas is used in a plasma treatment performed on the surface of the substrate, a roughness of the surface of the substrate may be increased and hydrophilic performance of the substrate may be improved consequently. Therefore, to improve hydrophobic performance of a hydrophobic component, a plasma treatment may be performed on the surface of the substrate.

[0032] Referring to FIG. 1, a method for fabricating a hydrophobic component is provided in one embodiment of the present disclosure, including:

511, providing a substrate;

512, performing a plasma treatment on the substrate by using a gas which is capable of etching a surface of the substrate; and

513, forming a low surface energy coating on the substrate.

[0033] In the embodiment, the surface of the substrate is etched using the plasma treatment to increase a roughness of the surface of the substrate. After the low surface energy coating is formed on the substrate's rough surface, the rough surface of the substrate is combined with the low surface energy coating, which in turn increases a contact angle of the low surface energy coating and thus improves hydrophobicity of the hydrophobic component.

[0034] Hereinafter, the above method will be described in detail.

[0035] First, in S11, a substrate is provided.

[0036] The substrate may be made of a transparent material, such as glass or plastic. The substrate may also be an opaque material, such as metal and ceramic.

[0037] In some embodiments, a shape, a size and a thickness of the substrate can be determined according to actual requirement.

[0038] In some embodiments, to clean the substrate, an ultrasonic cleaning process may be performed on the substrate with a mixed solution of acetone, isopropyl ketone and deionized water. Thus, impurities on the surface of the substrate may be

removed. Consequently, subsequent processes can be performed without considering the impact of the impurities. The ultrasonic cleaning process is well known in the art and not described in detail here.

[0039] In S12, a plasma treatment is performed on the substrate.

[0040] Plasma treatment is performed to rough the surface of the substrate, so a gas which is capable of etching the surface of the substrate in the plasma treatment is needed. In some embodiments, the gas may include at least one selected from a group consisting of Ar, a mixed gas of SF_6 and O_2 , a mixed gas of CF_4 and O_2 .

[0041] A flow rate of the gas should be appropriate. If the flow rate of the gas is too low, the efficiency of the plasma treatment may be affected and the surface of the substrate may hardly be roughened. If the flow rate of the gas is too high, that may be a waste of gas and a processing efficiency may be reduced due to strong collision of the gas molecules. In some embodiments, the flow rate of the gas may range from 20sccm to 60sccm, for example, 20sccm, 40sccm or 60sccm.

[0042] The plasma treatment may be performed using an existing plasma processing and is not described in detail here.

[0043] In S13, a low surface energy coating is formed on the substrate.

[0044] In some embodiments, the low surface energy coating may include at least one selected from a group consisting of methoxysilane, alkylsilane, fluorine-containing silane, and grafted-siloxane chain compounds.

[0045] In some embodiments, the low surface energy coating may be formed by at least one selected from a group consisting of chemical vapor deposition, spinning, spraying, wet chemistry methods, chemical sol-gel, chemical liquid deposition, photoetching, template, physical vapor position, evaporation and sputtering.

[0046] If carbon chains in the low surface energy coating are too short, surface energy may be too high and the hydrophobic performance may be degraded. If the carbon chains in the material of the low surface energy coating are too long, the

chains may be easily broken and a poor stability may be resulted in. In some embodiments, the low surface energy coating includes hexadecyltrimethoxysilane (HDTMS). Length of carbon chains of HDTMS is suitable, which may result in a good hydrophobic performance with a high stability.

[0047] In some embodiments, referring to FIG. 2, forming the low surface energy coating on the surface of the substrate may include:

in S131, providing HDTMS;

in S132, adding ethanol into the hexadecyltrimethoxysilane to form a solution;

in S133, acidizing the solution;

in S134, stirring the solution after acidizing; and

in S135, coating the surface of the substrate with the solution by soaking, spinning or spraying.

[0048] Specifically, HDTMS with a chemical formula of $\text{CH}_3(\text{CH}_2)_{15}\text{Si}(\text{OCH}_3)_3$ is provided.

[0049] The inventors found that HDTMS is easily soluble in the ethanol, thus, the ethanol is added into the HDTMS to form the solution. In some embodiments, a mass percentage of the HDTMS to the solution may be within a range from 3% to 5%.

[0050] Hereinafter, the solution is acidized so that the HDTMS is hydrolyzed and active hydroxyl groups are generated. In some embodiments, at least one of acetic acid, hydrochloric acid and nitric acid is added into the solution to make a PH value of the solution within a range from 4.5 to 5.5, for example, 4.5, 5.0 or 5.5.

[0051] Hereinafter, the acidized solution is stirred to make the HDTMS hydrolyze adequately and uniformly. In some embodiments, the acidized solution is disposed in a stirring device to be stirred for more than 60 minutes.

[0052] Hereinafter, the stirred solution is coated on the surface of the substrate as

the low surface energy coating. In some embodiments, the stirred solution may be formed on the surface of the substrate by soaking, spinning or spraying.

[0053] In some embodiments, soaking may be used to coat the stirred solution on the surface of the substrate. In some embodiments, for an adequate reaction, the substrate is disposed in the stirred solution for 30 minutes to 60 minutes, for example, 30 minutes, 40 minutes, 50 minutes or 60 minutes. The soaking process may be performed at room temperature using simple operations. Besides, no extra device is required and the low surface energy coating may be distributed on the surface of the substrate uniformly.

[0054] In some embodiments, spinning or spraying may be used to coat the stirred solution on the surface of the substrate, which coating process is relatively short in time and thus is of high efficiency to obtain a uniform low surface energy coating distributed on the surface of the substrate.

[0055] Thus, the low surface energy coating is formed on the surface of the substrate. A thickness of the low surface energy coating may be of molecular level. In some embodiments, the thickness of the low surface energy coating may be within a range from 10nm to 500nm, for example, 10nm, 50nm, 100nm, 250nm or 500nm.

[0056] Furthermore, after the low surface energy coating is formed, the low surface energy coating may be dried in the air at room temperature and processed with a solidification process. Specifically, the solidification process may be performed for about 30 minutes to 60 minutes, for example, 30 minutes, 40 minutes, 50 minutes or 60 minutes, at a temperature within a range from 100°C to 150°C, for example, 100°C, 110°C, 120°C, 130°C, 140°C or 150°C.

[0057] Through the solidification process, the low surface energy coating may be attached on the surface of the substrate tightly, which may avoid the low surface energy coating falling off.

[0058] In the above embodiment, the low surface energy coating is formed on the

rough surface of the substrate directly, which increases the contact angle of the low surface energy coating. If a contact angle of a surface of a substrate is 40° and a low surface energy coating is formed on the surface of the substrate directly, a contact angle of the low surface energy coating is 100°. In contrast, for example, if a plasma treatment is performed on the substrate using Ar with a radio frequency power ranging from 100W to 500W, under a gas flow rate ranging from 20sccm to 60sccm and under a gas pressure ranging from 20mTorr to 200mTorr or atmospheric pressure (about 760Torr) for about one minute, the contact angle of the low surface energy coating formed on the rough surface of the substrate is 130°. Therefore, by performing the plasma treatment on the surface of the substrate before forming the low surface energy coating, the contact angle of the low surface energy coating is increased and the hydrophobicity of the hydrophobic component is improved, which may realize self-cleaning and anti-freezing functions for the hydrophobic component.

[0059] Referring to FIG. 3, a method for fabricating a hydrophobic component is provided in one embodiment of the present disclosure, including:

521, providing a substrate;

522, performing a plasma treatment on the substrate by using a gas which is capable of forming hydroxyls on a surface of the substrate; and

523, forming a low surface energy coating on the substrate.

[0060] In the embodiment, the plasma treatment is performed to form hydroxyls (OH⁻) on the surface of the substrate, so that the surface of the substrate turns hydrophilic. After the low surface energy coating is formed on the hydrophilic substrate, the low surface energy coating is more easily formed on the surface of the substrate through the hydroxyls, thereby increasing a contact angle of the low surface energy coating and thus improving the hydrophobicity of the hydrophobic component.

[0061] Except that the gas used in the plasma treatment in S22 is different from that in S12, other details of the method in the embodiment is similar to those in the above

embodiment and is not described in detail here.

[0062] S22 is performed to form the hydroxyls on the surface of the substrate, so a gas which is capable of forming hydroxyls on the surface of the substrate is needed. In some embodiments, the gas used in the plasma treatment may include at least one selected from a group consisting of O_2 , H_2O , air and a mixed gas of O_2 and O_3 , and a mixed gas of O_2 and H_2O_2 .

[0063] A flow rate of the gas should be appropriate. If the flow rate of the gas is too low, the efficiency of the plasma treatment may be low and the hydroxyls formed on the surface of the substrate may not be enough. If the flow rate of the gas is too high, that may be a waste of gas. In some embodiments, the flow rate of the gas may range from 20sccm to 60sccm, for example, 20sccm, 40sccm or 60sccm.

[0064] In the embodiment, the low surface energy coating is formed on the hydrophilic surface of the substrate directly, thereby increasing the contact angle of the low surface energy coating. If a contact angle of a surface of a substrate is 40° and a low surface energy coating is formed on the surface of the substrate directly, a contact angle of the low surface energy coating is 100° . In contrast, if a plasma treatment is performed on the substrate using O_2 with a radio frequency power ranging from 100W to 500W, under a gas flow rate ranging from 20sccm to 60sccm, and under a gas pressure of 80mTorr for about one minute, the contact angle of the surface of the substrate turns smaller than 10° while the contact angle of the low surface energy coating formed on the surface of the substrate is 130° . Therefore, by performing the plasma treatment on the surface of the substrate before forming the low surface energy coating, the contact angle of the low surface energy coating can be increased and the hydrophobicity of the hydrophobic component can be improved, which may realize self-cleaning and anti-freezing functions for the hydrophobic component.

[0065] Referring to FIG. 4, a method for fabricating a hydrophobic component is provided in one embodiment of the present disclosure, including:

531, providing a substrate;

532, performing a plasma treatment on the substrate by using a gas which is capable of etching a surface of the substrate and a gas which is capable of forming hydroxyls on the surface of the substrate; and

533, forming a low surface energy coating on the substrate.

[0066] In the embodiment, the plasma treatment is performed to rough the surface of the substrate and form hydroxyls on the surface of the substrate. Compared with the above embodiments, a contact angle of the low surface energy coating is further increased and the hydrophobicity of the hydrophobic component is further improved.

[0067] S31 and S33 of the method in the embodiment are similar to those in the above embodiments and are not described in detail here.

[0068] The gas used in the plasma treatment may include two types of gas. The first type may include at least one selected from a group consisting of a mixed gas of SF_6 and O_2 , a mixed gas of CF_4 and O_2 , and Ar, which can increase a roughness of the surface of the substrate. The second type may include at least one selected from a group consisting of O_2 , H_2O , air, a mixed gas of O_2 and H_2 , and a mixed gas of O_2 and H_2O_2 , which can make the surface of the substrate hydrophilic. In some embodiments, a flow rate of the gas may range from 20sccm to 60sccm, for example, 20sccm, 40sccm or 60sccm.

[0069] In an embodiment, the plasma treatment is performed using O_2 and Ar with a radio frequency power of 300W, under a gas flow rate ranging from 20sccm to 60sccm and under a gas pressure ranging from 20mTorr to 200mTorr or atmospheric pressure (about 760Torr) for about one minute.

[0070] From above, the contact angle of the low surface energy coating can be increased when the low surface energy coating is formed on the substrate with a rough surface or a hydrophilic surface. Therefore, compared with the embodiments shown in FIGs. 1 and 3, the contact angle of the low surface energy coating in the

embodiment can be further increased and the hydrophobicity of the hydrophobic component can be greatly improved.

[0071] FIG. 5 schematically illustrates a structure of a hydrophobic component fabricated by above embodiments. The hydrophobic component includes a substrate 100 and a low surface energy coating 200 formed on the substrate 100.

[0072] In each of the above embodiments, a plasma treatment is performed on the substrate 100 in fabricating the hydrophobic component, which increases a contact angle of the low surface energy coating 200 and further improves the hydrophobicity of the hydrophobic component.

[0073] Referring to FIG. 6, a method for fabricating a hydrophobic component is provided according to one embodiment of the present disclosure. The method includes:

541, providing a substrate;

542, forming an anti-reflection coating on the substrate;

543, performing a plasma treatment on the anti-reflection coating; and

544, forming a low surface energy coating on the anti-reflection coating.

[0074] Compared with the above embodiments shown in FIGs. 1, 3 and 4, the anti-reflection coating is formed on the substrate before a plasma treatment is performed. Therefore, an anti-reflection ability of the hydrophobic component can also be improved as well as the hydrophobicity.

[0075] S41 and S44 may be performed similarly to S11 and S13 respectively. The plasma treatment in S43 may be performed similarly as the plasma treatment described in any embodiment described above.

[0076] The anti-reflection coating may be a single layer structure or multiple-layer structure. The anti-reflection coating may include at least one selected from a group consisting of zinc oxide, silicon, silicon oxide, titanium oxide, silicon nitride,

tantalum oxide, zirconium oxide, aluminum oxide, indium oxide, tin oxide, gallium oxide, tin-doped indium oxide, fluorinated tin-doped indium oxide, fluorine-doped indium oxide, aluminum-doped zinc oxide, gallium-doped zinc oxide, zinc sulfide, zinc selenide and magnesium fluoride.

[0077] In some embodiments, the anti-reflection coating may have a thickness within a range from about 100nm to about 2000nm, for example, 100nm, 500nm, 1000nm or 2000nm.

[0078] In some embodiments, the anti-reflection coating may include at least one selected from a group consisting of porous silicon oxide, porous titanium oxide, porous aluminum oxide and porous zirconium oxide, to realize an anti-reflection effect. In one embodiment, the plasma treatment is performed using O₂ and/or Ar with a radio frequency power of 300W, under a gas flow rate ranging from 20sccm to 60sccm and under a gas pressure of 80mTorr for a time period of about 1 minute. In other embodiments, the gas, the radio frequency source, the gas flow rate, the gas pressure and a time period of the plasma treatment may be adjusted according to actual requirement, which does not limit the scope of the disclosure.

[0079] Referring to FIG. 7, the hydrophobic component fabricated by the method shown in FIG. 6 is provided. The hydrophobic component includes:

the substrate 100;

an anti-reflection coating 300 formed on the substrate 100; and

the low surface energy coating 200 formed on the anti-reflection coating 300.

[0080] In the above embodiment, a plasma treatment is performed in fabricating the hydrophobic component, which increases a contact angle of the low surface energy coating 200 and further improves the hydrophobicity of the hydrophobic component.

[0081] In some embodiments, the hydrophobic component may be used for incident light having a wavelength greater than 300nm, that is, the hydrophobic component

allows the incident light having a wavelength greater than 300nm to penetrate the hydrophobic component. In some embodiments, the hydrophobic component is used for incident light having a wavelength ranging from 300nm to 1000nm, for example, 300nm, 500nm, 800nm or 1000nm.

[0082] For example, FIG. 8 illustrates relations (solid line) between light transmittance of the hydrophobic component, which is fabricated by performing a plasma treatment on the anti-reflection coating using Ar, and wavelength of incident light, and relations (dotted line) between light transmittance of the hydrophobic component, which is fabricated without performing a plasma treatment on the anti-reflection coating, and wavelength of incident light. It can be seen from FIG. 8, the plasma treatment hardly impact the transmittance of the hydrophobic component, that is, negative influence of the plasma treatment to the transmittance of the anti-reflection coating can be ignored. For incident light having a wavelength within a range from 300nm to 1000nm, the plasma treatment can further improve the transmittance of the hydrophobic component due to the increased surface holes on the anti-reflection coating 300 after the plasma treatment accounting for the reduction of a refraction coefficient of the anti-reflection coating 300.

[0083] For another example, FIG. 9 illustrates relations (solid line) between light transmittance of the hydrophobic component, which is fabricated by performing a plasma treatment on the anti-reflection coating using O_2 , and wavelength of incident light, and relations (dotted line) between light transmittance of the hydrophobic component, which is fabricated without performing a plasma treatment on the anti-reflection coating, and wavelength of incident light. It can be seen from FIG. 9, the plasma treatment hardly impact the transmittance of the hydrophobic component, that is, negative influence of the plasma treatment to the transmittance of the anti-reflection coating can be ignored. For incident light having a wavelength within a range from 300nm to 800nm, the plasma treatment can further improve the transmittance of the hydrophobic component.

[0084] By comparing FIG. 8 with FIG. 9, the hydrophobic component processed with the plasma treatment on the anti-reflection coating using Ar has better transmittance than that with the plasma treatment on the anti-reflection coating using O_2 . That is, the anti-reflection ability may be better enhanced when a gas which is capable of etching the surface of the substrate is used in the plasma treatment.

[0085] Referring to FIG. 10, a photovoltaic device is provided according to one embodiment of the present disclosure, including a hydrophobic component and a solar cell 400. The hydrophobic component includes the substrate 100, the anti-reflection coating 300 formed on one side of the substrate 100 and the low surface energy coating 200 formed on the anti-reflection coating 300. The substrate 100 is transparent. The solar cell 400 is disposed on another side of the substrate 100, i.e., on a side of the substrate 100 which does not have the anti-reflection coating 300 formed thereon.

[0086] The hydrophobic component may be formed using the method illustrated in FIG. 6, which is not described in detail here.

[0087] In some embodiments, the substrate 100 includes a transparent material, such as glass or plastic.

[0088] In some embodiments, the solar cell 400 may be any kind of existing solar cell, for example, an amorphous silicon thin film solar cell or a microcrystalline silicon thin film solar cell, which should not limit the scope of the disclosure.

[0089] A plasma treatment is performed in fabricating the hydrophobic component, which results in an improved hydrophobicity for the hydrophobic component, and thus enables the photovoltaic device to have abilities of self-cleaning, anti-fingerprint, anti-fogging. Besides, the plasma treatment may not affect the anti-reflection ability of the anti-reflection coating 300, and can instead improve the transmittance of the anti-reflection coating 300 within a portion of wavelength, which contributes a better anti-reflection performance to the photovoltaic device.

[0090] Although the present disclosure has been disclosed above with reference to preferred embodiments thereof, it should be understood that the disclosure is presented by way of example only, and not limitation. Those skilled in the art can modify and vary the embodiments without departing from the spirit and scope of the present disclosure. Therefore, the protection scope of the present disclosure is subject to the scope defined by the claims.

WHAT IS CLAIMED IS:

1. A method for fabricating a hydrophobic component, comprising:
 - providing a substrate;
 - performing a plasma treatment on the substrate; and
 - forming a low surface energy coating on the substrate.
2. The method according to claim 1, wherein the plasma treatment uses a gas which is capable of etching a surface of the substrate.
3. The method according to claim 2, wherein the gas of the plasma treatment comprises at least one selected from a group consisting of a mixed gas of SF₆ and O₂, a mixed gas of CF₄ and O₂, and Ar.
4. The method according to claim 1, wherein the plasma treatment uses a gas which is capable of forming hydroxyls on a surface of the substrate.
5. The method according to claim 4, wherein the gas of the plasma treatment comprises at least one selected from a group consisting of O₂, H₂O, air, a mixed gas of O₂ and O₃, and a mixed gas of O₂ and H₂O₂.
6. The method according to claim 3 or 5, wherein a gas flow rate in the plasma treatment is within a range from 20sccm to 60sccm.
7. The method according to claim 1, wherein the plasma treatment uses a first gas and a second gas, where the first gas comprises at least one selected from a group consisting of Ar, a mixed gas of SF₆ and O₂, and a mixed gas of CF₄ and O₂, and the second gas comprises at least one selected from a group consisting of O₂, H₂O, air, a mixed gas of O₂ and O₃, and a mixed gas of O₂ and H₂O₂.
8. The method according to claim 1, wherein the substrate comprises glass, metal, ceramic or plastic.

9. The method according to claim 1, wherein the low surface energy coating comprises at least one selected from a group consisting of methoxysilane, alkylsilane, fluorine-containing silane, and grafted siloxane chain compounds.

10. The method according to claim 1, wherein a thickness of the low surface energy coating is within a range from 10nm to 500nm.

11. The method according to claim 1, wherein the low surface energy coating comprises hexadecyltrimethoxysilane, and the forming the low surface energy coating comprises:

providing hexadecyltrimethoxysilane;

adding ethanol in the hexadecyltrimethoxysilane to form a solution;

acidizing the solution;

stirring the solution after acidizing; and

coating a surface of the substrate with the solution by soaking, spinning or spraying.

12. The method according to claim 1, further comprising: forming an anti-reflection coating on the substrate before performing the plasma treatment.

13. The method according to claim 12, wherein the anti-reflection coating comprises at least one selected from a group consisting of zinc oxide, silicon, silica, titanium oxide, silicon nitride, tantalum oxide, zirconium oxide, aluminum oxide, indium oxide, tin oxide, gallium oxide, tin-doped indium oxide, fluorinated tin-doped indium oxide, fluorine-doped indium oxide, aluminum-doped zinc oxide, gallium-doped zinc oxide, zinc sulfide, zinc selenide and magnesium fluoride.

14. The method according to claim 13, wherein the anti-reflection coating comprises at least one selected from a group consisting of porous silicon oxide, porous titanium oxide, porous aluminum oxide and porous zirconium oxide; and the plasma treatment

is performed using O_2 and/or Ar with a radio frequency power ranging from 100W to 500W, under a gas flow rate ranging from 20sccm to 60sccm and under a gas pressure ranging from 20mTorr to 200mTorr or atmospheric pressure for about one minute.

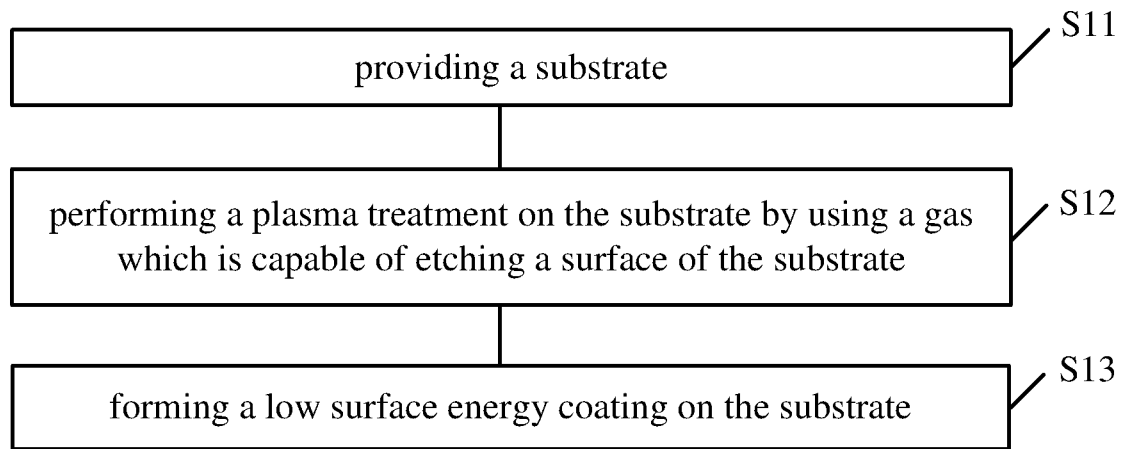
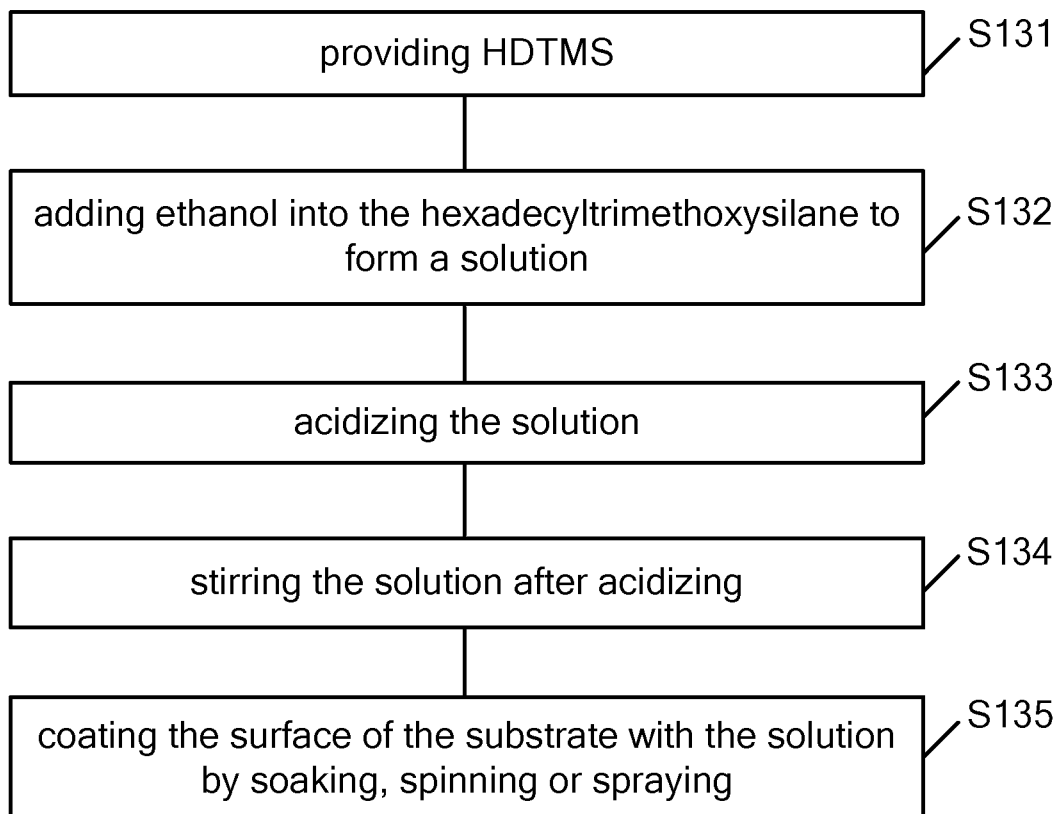
15. A hydrophobic component fabricated by the method according to any one of claims 1 to 14.

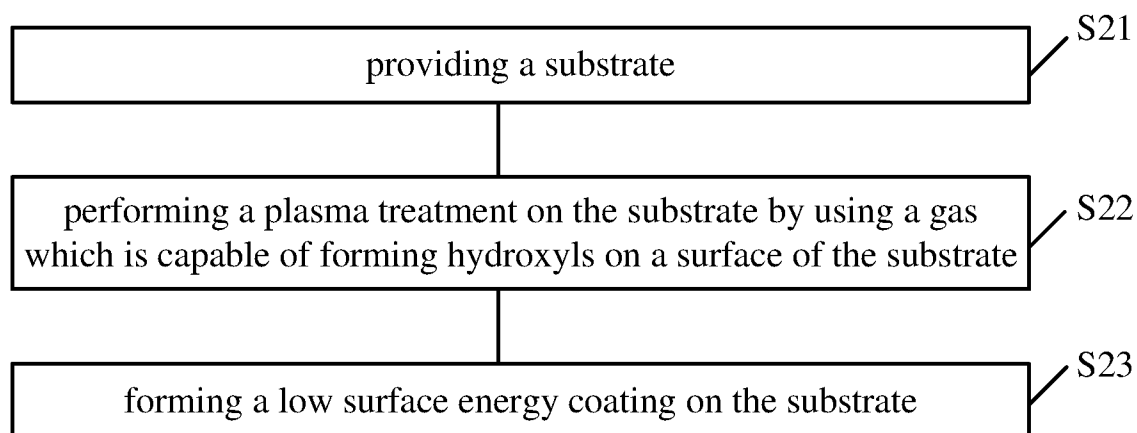
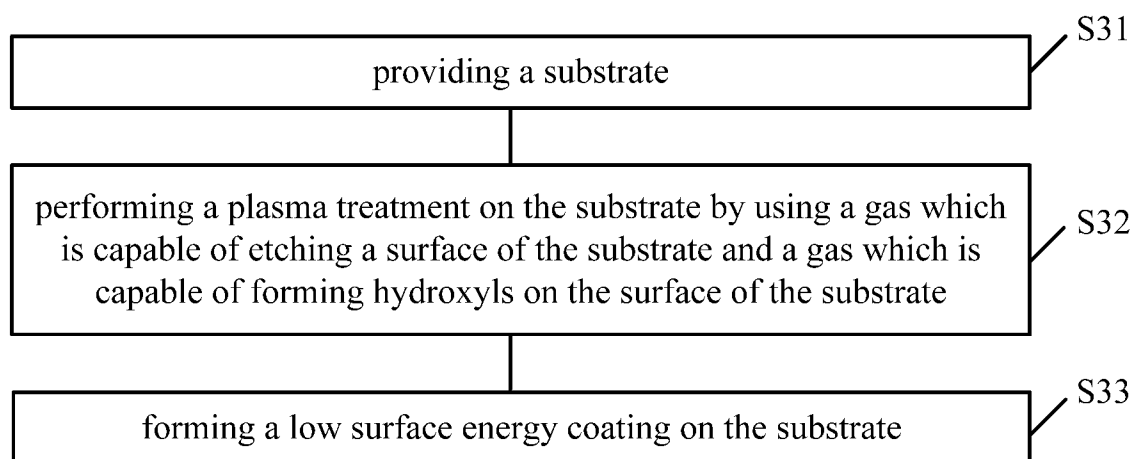
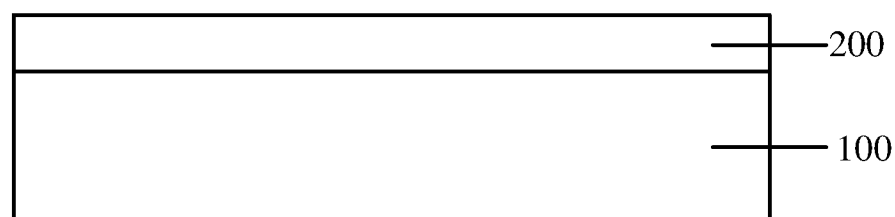
16. The hydrophobic component according to claim 15, wherein when the hydrophobic component is fabricated by the method according to claim 12, the hydrophobic component is used for incident light having a wavelength within a range from 300nm to 1000nm.

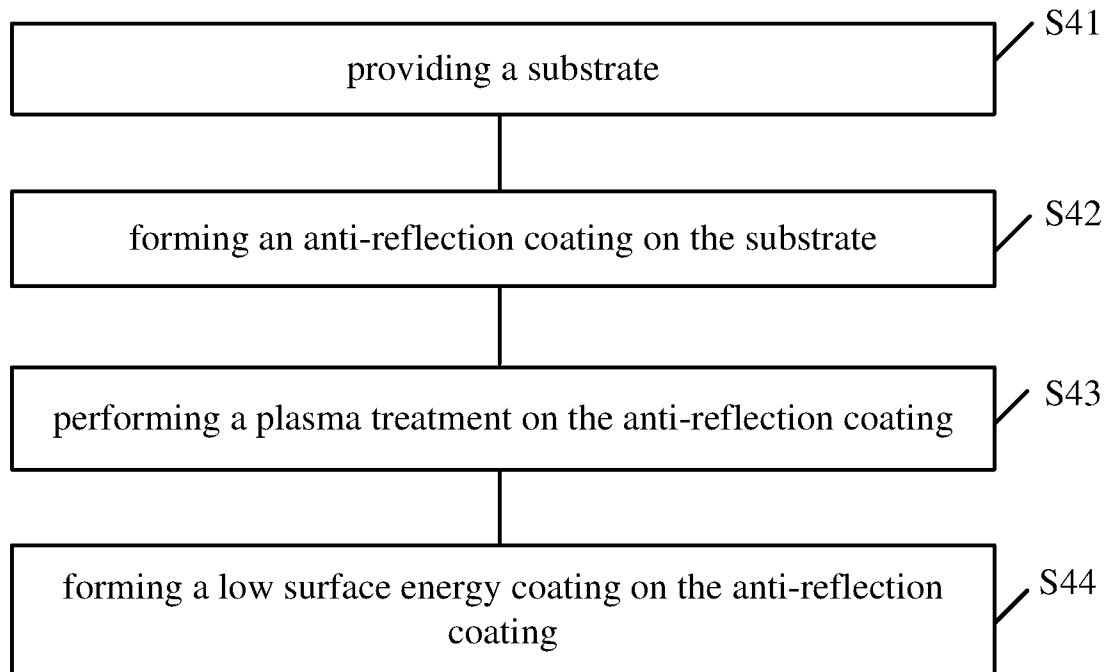
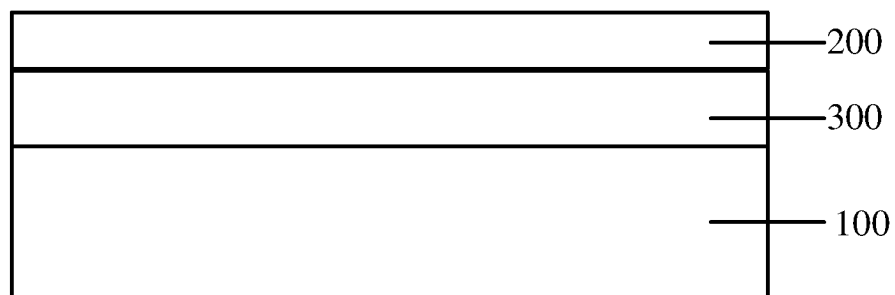
17. A photovoltaic device, comprising:

a hydrophobic component fabricated by the method according to any one of claims 12 to 14, where the substrate is transparent; and

a solar cell disposed on a side of the substrate which does not have the anti-reflection coating formed thereon.

**FIG. 1****FIG. 2**

**FIG. 3****FIG. 4****FIG. 5**

**FIG. 6****FIG. 7**

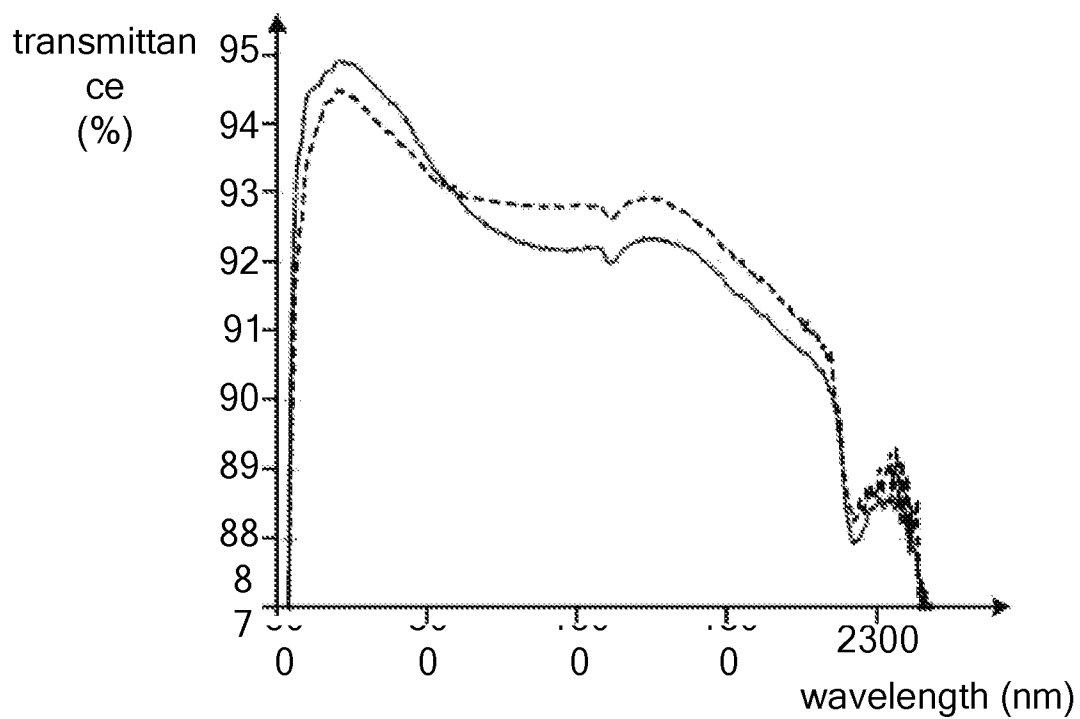


FIG. 8

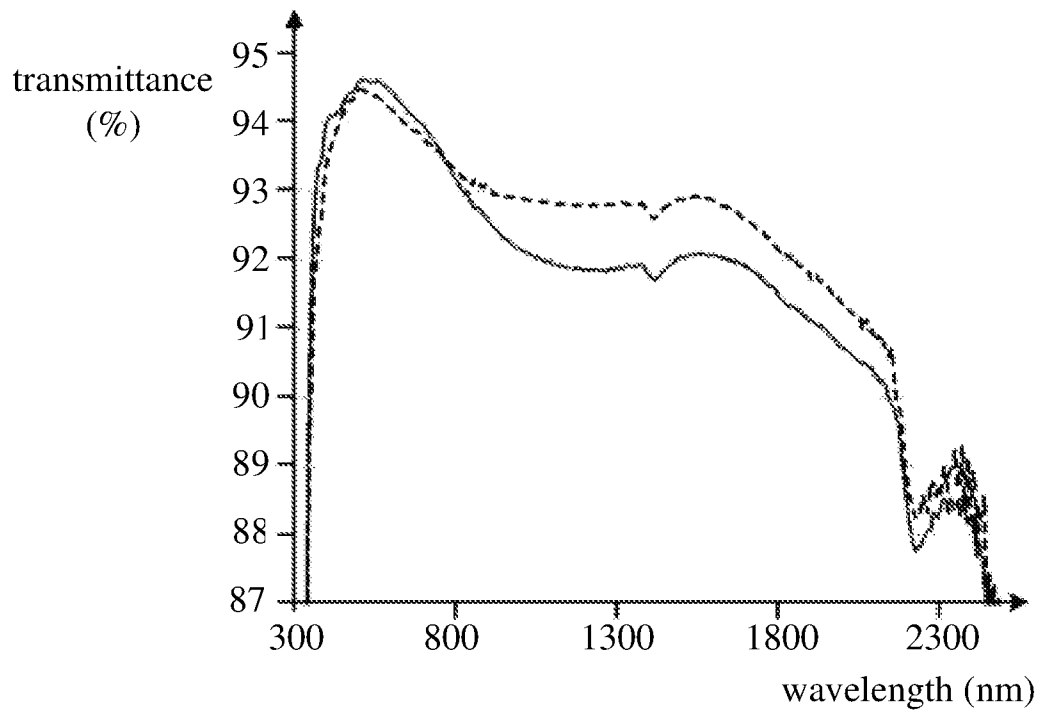


FIG. 9

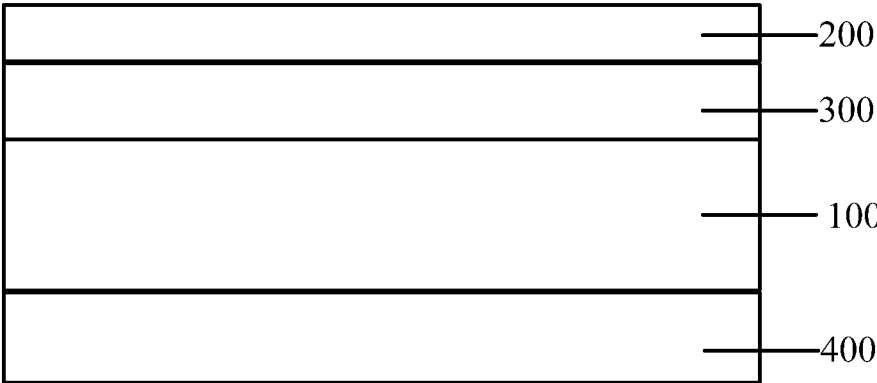


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2014/076472

A. CLASSIFICATION OF SUBJECT MATTER

H01L 31/18(2006.01)i; H01L 31/0216(2014.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, EPODOC, CNTXT, CNKI, CPRS: hydrophobic, photovoltaic, substrate, plasma, etch, low surface energy, coating, transparent, anti reflection, solar cell, contact angle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	CN 101423945B (NINGBO INSTITUTE OF MATERIAL TECHNOLOGY AND ENGINEERING CHINESE ACADEMY OF SCIENCES) 27 October 2010 (2010-10-27) paragraphs [0005]-[0025]	1. 2. 8. 9. 12. 13. 15-17
Y	CN 101423945B (NINGBO INSTITUTE OF MATERIAL TECHNOLOGY AND ENGINEERING CHINESE ACADEMY OF SCIENCES) 27 October 2010 (2010-10-27) paragraphs [0005]-[0025]	3-17
Y	CN 102804061A (HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.) 28 December 2012 (2012-12-28) paragraphs [0047]-[0048]	3. 6. 7. 14. 15-17
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Y	CN 102815052A (SAINT-GOBAIN GLASS FRANCE) 12 December 2012 (2012-12-12) paragraphs [0093], [0104]-[0105], [0135], [0137]-[0142], [0155]	8-17



Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

08 July 2014

Date of mailing of the international search report

30 July 2014

Name and mailing address of the ISA/

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Telephone No. (86-10)62411580

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2014/076472

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			EP 2385932A1	16 November 201 1
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