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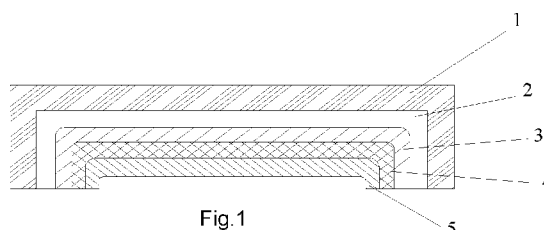


Fig. 1

(57) Abstract: A shell is provided, comprising a transparent membrane layer; a light transmittable pattern layer disposed onto at least part of an inner surface of the transparent membrane layer; a metal layer disposed onto an inner surface of the light transmittable pattern layer; a transparent injection layer disposed onto an outer surface of the transparent membrane layer; and a protective layer disposed onto an inner surface of the metal layer. A method of preparing the shell is provided. An electronic product comprising the shell is also provided.



SHELL, METHOD OF PREPARING THE SHELL AND ELECTRONIC PRODUCT COMPRISING THE SHELL

CROSS-REFERENCE TO RELATED APPLICATION

5 This application claims priority to, and benefits of Chinese Patent Application No. 201010216420.5 filed with State Intellectual Property Office, P. R. C. on June 28, 2010, the entire content of which is incorporated herein by reference.

FIELD

10 The present disclosure relates to a shell, a method of preparing the shell, and an electronic product comprising the shell.

BACKGROUND

Conventionally, a shell for an electronic product is mainly formed by injecting plastic
15 materials to form an injection layer and then decorating the surface of the injection layer by coating and/or electroplating. In-mold decoration (IMD) process may also be used to form a shell for an electronic product, which comprises a hardened transparent membrane layer, an injection layer, and a printed pattern layer between the membrane layer and the injection layer. Moreover, a shell for an electronic product may also be prepared by the
20 injecting a plastic material to form a housing and then laminating a metal layer on the housing. However, with the electronic product shells formed by the conventional method, their decorated layer (including pattern decoration layer) are located on the surface or near the surface of the shell, which may not offer deep visual effects. Thus, the consumers' higher and higher requirements for the appearance of electronic products
25 shells may not be satisfied.

SUMMARY

The present disclosure is directed to solve at least one of the problems existing in the prior art. Accordingly, there is provided a shell with deep visual effects and metal quality. A
30 method of preparing the shell is provided. Further, an electronic product comprising the shell is also provided.

In one aspect, a shell comprises a transparent membrane layer; a light transmittable pattern layer disposed onto at least part of an inner surface of the transparent membrane layer; a metal layer disposed onto an inner surface of the light transmittable pattern layer;
35 a transparent injection layer disposed onto an outer surface of the transparent membrane layer; and a protective layer disposed onto an inner surface of the metal layer.

In another aspect, a method of preparing a shell comprises the steps of: providing a transparent membrane layer; forming a light transmittable pattern layer on at least part of an inner surface of the transparent membrane layer; forming a metal layer on an inner surface of the light transmittable pattern layer; forming a protective layer on an inner surface of the metal layer; molding and shaping the transparent membrane layer with the light transmittable pattern layer, the metal layer and the protective layer formed sequentially thereon; and forming a transparent injection layer on an outer surface of the shaped transparent membrane layer.

In still another aspect, an electronic product comprising a body and a shell adapted to the body is also provided. The shell is any one described above.

According to embodiments of the present disclosure, the shell for the electronic product may have the light transmittable pattern layer on the inner surface and the transparent injection layer on the outer surface, which may provide the shell with deep visual effects and metal quality. Also, with the method of preparing the shell according to an embodiment of the present disclosure, some post-treatment steps such as coating step and electroplating step after injecting may be avoided, thus not only reducing the process time and the cost for preparing the shell, but also avoiding environmental pollution caused by coating and electroplating processes.

Additional aspects and advantages of the embodiments of the present disclosure will be given in part in the following descriptions, become apparent in part from the following descriptions, or be learned from the practice of the embodiments of the present disclosure.

BRIEF DISCRETION OF DRAWINGS

These and other aspects and advantages of the present disclosure will become apparent and more readily appreciated from the following descriptions taken in conjunction with the drawings, in which:

Fig. 1 is a cross-sectional view of a shell for an electronic product according to an embodiment of the disclosure; and

Fig. 2 is a flow chart of the method of preparing a shell according to an embodiment of the disclosure.

DETAILED DISCRETION

Reference will be made in detail to embodiments of the present disclosure. The embodiments described herein are explanatory, illustrative, and used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure. The same or similar elements and the elements having same or similar

functions are denoted by like reference numerals throughout the descriptions.

In the description, Unless specified or limited otherwise, relative terms such as "central", "longitudinal", "lateral", "front", "rear", "right", "left", "inner", "outer", "lower", "upper", "horizontal", "vertical", "above", "below", "up", "top", "bottom" as well as derivative thereof (e.g., "horizontally", "downwardly", "upwardly", etc.) should be construed to refer to the orientation as then described or as shown in the drawings under discussion. These relative terms are for convenience of description and do not require that the present disclosure be constructed or operated in a particular orientation.

As shown in Fig. 1, a shell according to an embodiment of the present disclosure comprises a transparent injection layer 1, a transparent membrane layer 2 disposed onto an inner surface of the transparent injection layer 1, a light transmittable pattern layer 3 disposed onto at least part of an inner surface of the transparent membrane layer 2, a metal layer 4 disposed onto an inner surface of the light transmittable pattern layer 3, and a protective layer 5 disposed onto an inner surface of the metal layer 4.

In one embodiment, the transparent membrane layer 2 may be formed on a part or whole of an inner surface of the pattern layer 3. The size and the location of the pattern layer 3 on the transparent membrane layer 2 may be determined according to different requirements.

The transparent membrane layer 2 may be any suitable membrane layer for electronic product shells, such as plastic sheets. In one embodiment, the transparent membrane layer 2 may be formed by polycarbonate (PC), polymethyl methacrylate (PMMA), polyethylene terephthalate (PET), or any combination thereof. In one embodiment, the membrane layer may have a thickness of about 0.125-0.25 mm.

In one embodiment, the transparent injection layer 1 may be formed by polycarbonate (PC) and/or polymethyl methacrylate (PMMA) with high transparency. In an alternative embodiment, the transparent membrane layer 2 is formed by PC or PET, and the transparent injection layer 1 may be formed by transparent PC materials. In a further alternative embodiment, the transparent membrane layer 2 is formed by PMMA, and the transparent injection layer 1 may be formed by transparent PMMA materials, thus enhancing joining force between the transparent membrane layer 2 and the transparent injection layer 1.

In one embodiment, the metal layer 4 may be formed by a material selected from the group consisting of: aluminum, indium, tin, copper, nickel, stainless steel, and any alloy thereof. In an alternative embodiment, the metal layer 4 may be formed by aluminum, indium, or an indium-tin alloy.

In one embodiment, the protective layer 5 may be an ink layer printed on the metal

layer 4, thus preventing the metal layer 4 from being destroyed.

According to another embodiment of the present disclosure, as shown in Fig.2, a method of preparing a shell comprises the steps of: providing a transparent membrane layer 2; forming a light transmittable pattern layer 3 on at least part of an inner surface of the transparent membrane layer 2; forming a metal layer 4 on an inner surface of the light transmittable pattern layer 3; forming a protective layer 5 on an inner surface of the metal layer 4; molding and shaping the transparent membrane layer 2 with the light transmittable pattern layer 3, the metal layer 4 and the protective layer 5 formed sequentially thereon; and forming a transparent injection layer 1 on an outer surface (non-decorated surface) of the shaped transparent membrane layer 2.

In one embodiment, the pattern layer 3 may be formed on the inner surface of the transparent membrane layer 2 by screen printing. Particularly, a pattern is printed on the inner surface of the transparent membrane layer 2 by using a screen, and the transparent membrane layer 2 printed with the pattern is dried for example in a furnace to solidify printed inks, in which the temperature inside the furnace may be controlled at about 80°C-90°C. In alternative embodiments, the light transmittable pattern layer 3 may also be formed on the transparent membrane layer 2 by may known methods such as heat transfer printing, water transfer printing, or ink jet printing.

In one embodiment, the metal layer 4 may be formed on the inner surface of the pattern layer 3 by using physical vapor deposition (PVD) and/or mirror ink printing. PVD includes vacuum evaporation plating, magnetron sputtering deposition, and ion plating. In an alternative embodiment, magnetron sputtering deposition may be used, because the adhesion force between the metal layer 4 formed by magnetron sputtering deposition and the light transmittable pattern layer 3 is large. Transparency of the metal layer 4 may be selected according to required metal feeling effects. For example, in one embodiment, the metal layer 4 may have a low transparency or even have transparency of about 0 to realize the obvious metal feeling. In another embodiment, the metal layer 4 may have high transparency if the metal quality is not required to be obvious. The PVD may be used to form a thin metal layer only on a whole surface of a substrate, and can not be used to form a thin metal layer on a part of the surface of the substrate. Therefore, in order to form a metal layer 4 on a part of the inner surface of the light transmittable pattern layer 3 (that is, the pattern layer 3 covering a part of the inner surface of the transparent membrane layer 2), an ink layer may be printed on a part of the inner surface of the metal layer 4 corresponding to the light transmittable pattern layer 3, and then the remaining metal layer 4 (the part of the metal layer without inks) is removed in a deplating solution. In an alternative embodiment, the metal layer 4 may be formed on the inner surface of the light

transmittable pattern layer 3 by printing mirror inks.

In one embodiment, the protective layer 5 may be printed on the inner surface of the metal layer 4 to protect the metal layer 4.

In one embodiment, the transparent membrane layer 2 with the light transmittable pattern layer 3, the metal layer 4, and the protective layer 2 formed sequentially thereon may be molded and shaped (sized) to required shapes. The molding method may include hot press molding and/or high pressure molding. In one embodiment, when the transparent membrane layer 2 is formed by PC, the high pressure molding is advantageous. In an alternative embodiment, when the transparent membrane layer 2 is formed by PET or PMMA, the hot press molding is advantageous. The hot press molding may include the steps of: placing the transparent membrane layer 2 with the light transmittable pattern layer 3, the metal layer 4 and the protective layer 5 formed sequentially thereon in a hot pressing mould; pre-heating with infrared radiation at a temperature of about 300-340 °C for about 15-20 seconds to soft the transparent membrane layer 2, and removing the infrared heating device and closing the mould to form the transparent membrane layer 2 with desired shapes. The high pressure molding may include the steps of: placing the transparent membrane layer 2 with the light transmittable pattern layer 3, the metal layer 4 and the protective layer 5 formed sequentially thereon in a high pressure mould; pre-heating with infrared radiation at a temperature of about 300°C for about 10 seconds; and removing the infrared heating device and closing the mould to form transparent membrane layer 2 with desired shapes, in which the mould temperature is about 120-130°C and the pressure is about 20 Kg.

In one embodiment, the molded transparent membrane layer 2 may be shaped by any known method such as cutting in a pressing and cutting machine.

In one embodiment, the step of forming a transparent injection layer 1 on the outer surface of the shaped transparent membrane layer 2 may comprise the steps of: placing the shaped transparent membrane layer 2 in a moving mould of an injection mould, positioning and closing the injection mould; and injecting an injection layer on the outer surface (the non-decorated surface) of the transparent membrane layer 2. In one embodiment, the injection layer is formed by injecting PC on the outer surface of the transparent membrane layer 2, the mould temperature is controlled at about 80-90 °C and an injection material temperature is controlled at about 300-315 °C. In an alternative embodiment, the injection layer is formed by injecting PMMA on the outer surface of the transparent membrane layer 2, the mould temperature is controlled at about 60-80 °C and the injection material temperature is controlled at about 220-260 °C. PC and PMMA are resins with high transparency, which may provide the product with deep visual effects and

metal quality.

The shell for electronic products made by the method according to the present disclosure may comprise a transparent injection layer 1 at the outside, and a light transmittable pattern layer 3 and a metal layer 4 on the inner side, so that the shell may have metal quality with deep visual effects. In the prior art, the injected materials are generally injected onto a decorated side (the side with a pattern layer), therefore, the decorated inks may be blown away by the injected materials, thus causing disadvantageous influence on ink flowing. To avoid that disadvantageous influence, anti-flowing and thermal resistant inks may be printed for many times in the prior art, thus increasing the manufacturing cost. In the embodiments of the present disclosure, the injected material is not contacted directly with the light transmittable pattern layer, so that ink flowing may be avoided. And the thermal resistant inks may not be necessary, thus reducing the manufacturing cost. On the other hand, because the transparent membrane layer 2 is not formed on the outer surface of the shell, the solidification step of the transparent membrane layer 2 may be avoided, thus not only enhancing the mouldability of the transparent membrane layer 2, but also avoiding blackening, scratching, and wrinkling of the metal layer 4 during the molding process, which may significantly reduce the manufacturing cost of the shell.

According to a further embodiment of the present disclosure, an electronic product comprising the shell is also provided. The electronic product may comprise a body and a shell described above. The body may be a series of elements disposed in the shell, and may realize corresponding electric performances. The body may be any suitable electric body known in the art.

There are no special limits on the electronic products, and may be any known electronic products such as cell phones, electric dictionaries, MP3s, PDAs, laptops, or digital cameras.

An example of the present disclosure will be described below.

A PET sheet with a thickness of 0.188 mm was prepared. Semitransparent red inks were printed on an inner surface of a PET sheet to form a light transmittable pattern layer. The printed PET sheet was dried in a high temperature furnace to solidify the inks, in which the furnace temperature was controlled at 80-90°C.

The printed sheet was placed on a support in a vacuum room of a horizontal sputtering plating machine (UHS-360B, commercially available from Youwei Science and Technology Company, Shenzhen, P.R.C.), and firstly subjected to surface treatment by an infrared radio frequency plasma cleaner under the conditions of: a power of 600 W, an oxygen flow of 270 seem, a vacuum pressure of 5×10^{-2} torr, a temperature of 25°C, and a

cleaning time of 15 s. After 5 s, the cleaned sheet was sputtering plated under the conditions of: an In-Sn alloy target, a sputtering power of 2 KW, an argon flow of 90 seem, a sputtering temperature of 25°C, a vacuum pressure of 2×10^{-3} torr, and a sputtering time of 2 seconds, to form an In-Sn alloy layer on an inner surface of the light transmittable pattern layer. The In-Sn alloy layer has a thickness of 200 nm and a transparency of 0.

Inks were printed on an inner surface of the In-Sn alloy layer to form an ink layer. The printed sheet was immersed into a 5 wt% dilute nitric acid solution to deplate a part (the part without inks) of the In-Sn alloy layer. Then a protective layer such as a protective ink was printed on an inner surface of the ink layer.

The sheet was placed into a mould and subjected to hot pressing at a mould temperature of 50°C and an infrared radiation temperature of 320°C-340°C for 40 seconds. Then the molded sheet was cut into the desired shape.

The cut sheet was placed into a moving mould of a mould. Then the mould was closed. PC materials were injected on an outer surface (the surface without a pattern layer) of the sheet at a mould temperature of 80-90°C and an injection material temperature of 305-310°C under an injection pressure of 2×100 kg/cm² and a packing pressure 1000 kg/cm² to form the shell.

Reference throughout this specification to "an embodiment," "some embodiments," "one embodiment", "another example," "an example," "a specific examples," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the disclosure. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment", "in an embodiment", "in another example, "in an example," "in a specific examples," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that changes, alternatives, and modifications all falling into the scope of the claims and their equivalents may be made in the embodiments without departing from spirit and principles of the disclosure.

WHAT IS CLAIMED IS:

1. A shell, comprising:

a transparent membrane layer;

5 a light transmittable pattern layer disposed onto at least part of an inner surface of the transparent membrane layer;

a metal layer disposed onto an inner surface of the light transmittable pattern layer;

a transparent injection layer disposed onto an outer surface of the transparent membrane layer; and

a protective layer disposed onto an inner surface of the metal layer.

10

2. The shell according to claim 1, wherein the transparent injection layer is formed by polycarbonate, polymethyl methacrylate, or combinations thereof.

15 3. The shell according to claim 1, wherein the transparent membrane layer is formed by polycarbonate, polymethyl methacrylate, polyethylene terephthalate, or any combination thereof.

4. The shell according to claim 1, wherein the transparent membrane layer has a thickness of about 0.125-0.25 mm.

20

5. The shell according to claim 1, wherein the metal layer is formed by aluminum, indium, tin, copper, nickel, stainless steel, or any alloy thereof.

6. A method of preparing a shell, comprising the steps of:

25 providing a transparent membrane layer;

forming a light transmittable pattern layer on at least part of an inner surface of the transparent membrane layer;

forming a metal layer on an inner surface of the light transmittable pattern layer;

forming a protective layer on an inner surface of the metal layer;

30 molding and shaping the transparent membrane layer with the light transmittable pattern layer, the metal layer and the protective layer formed sequentially thereon; and

forming a transparent injection layer on an outer surface of the shaped transparent membrane layer.

35 7. The method according to claim 6, wherein the light transmittable pattern layer is formed by screen printing.

8. The method according to claim 6, wherein the metal layer is formed by using physical vapor deposition and/or printing mirror ink.

5 9. The method according to claim 6, wherein the protective layer is formed by printing ink on the inner surface of the metal layer.

10 10. The method according to claim 6, wherein the molding of the membrane layer with the light transmittable pattern layer, the metal layer and the protective layer formed sequentially thereon is performed by hot press molding and/or high pressure molding.

11. An electronic product comprising a body and a shell adapted to the body, wherein the shell is any one according to claims 1-5.

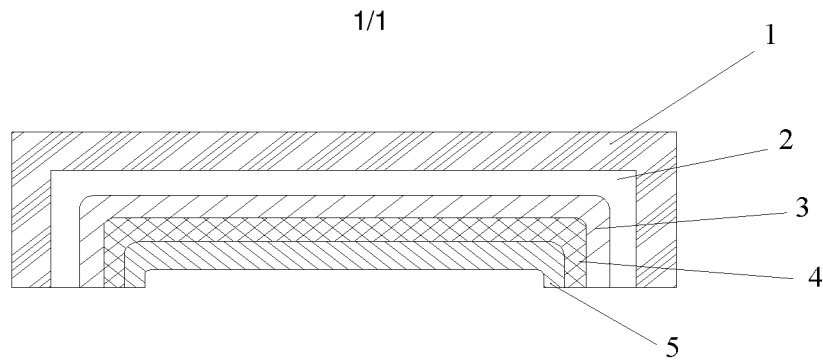


Fig.1

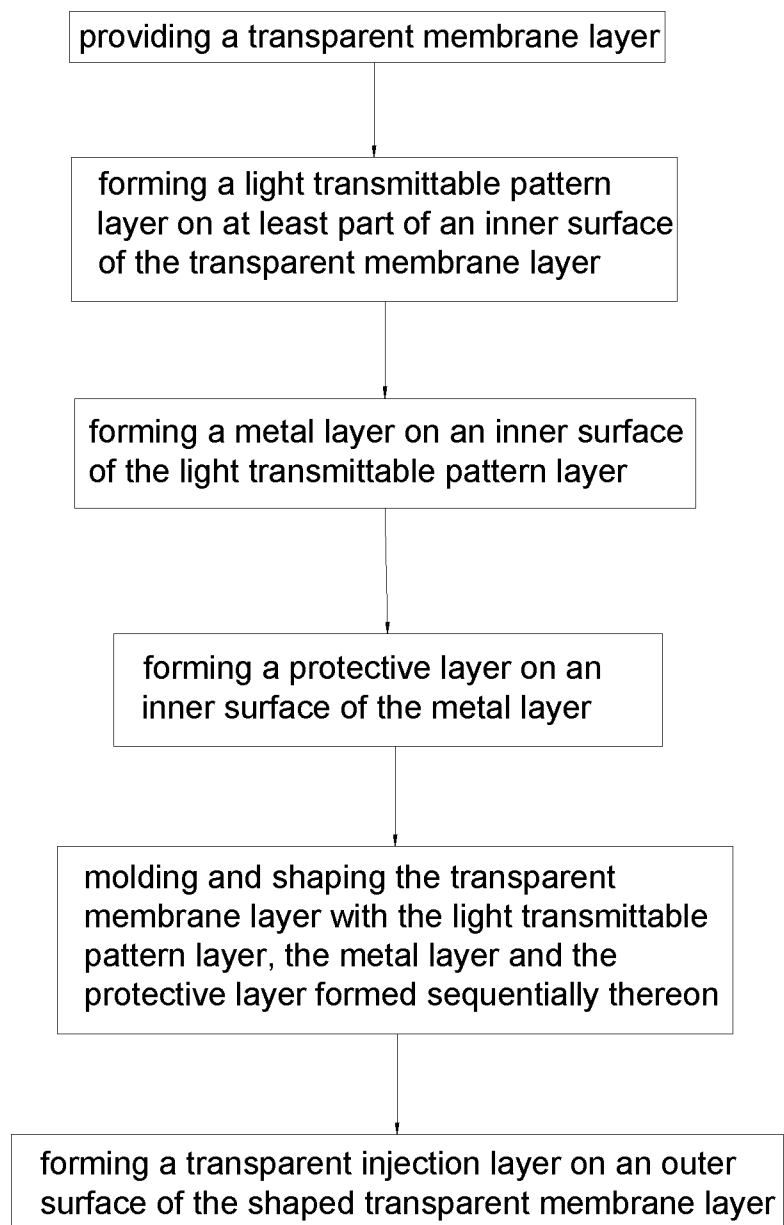


Fig.2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/073318

A. CLASSIFICATION OF SUBJECT MATTER

H05K5/00(2006.01) 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)

IPC: H05K5/-

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)

CNABS;CNTXT;CNKI;VEN: SHELL,CASING,HOUSING, PLAS TIC,FILM,MEMBRANCE, METAL, METALLIC, PATTERN,JECORAT+/AL JESIGN, INK, INJECTION, STEREO PERCEPTION; THREEDIMENSIONAL APPEAL; THREE-DIMENSION ,CUBIC,THREE-DIMENSIONAL,STEREOSCOPIC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category ¹ *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,Y	CN201563307U(BYD COMPANY LIMITED) 25 Aug. 2010(25.08.2010) Pages 2-3 of the description, figure 1	1-1 1
P,Y	CN101959378A(SHENZHEN FUTAIHONG PREC IND CO) 26 Jan. 2011(26.01 .2011) Pages 2-3 of the description, figure 1	1-1 1
Y	CN101554823A(SHENZHEN FUTAIHONG PREC IND CO) 14 Oct. 2009(14.10.2009) Page 2 line 2 - page 4 line 3 of the description, figure 1	1-1 1
Y	CN101005737A(HONGFUJTN PRECISION IND SHENZHEN CO LTD) 25 Jul. 2007(25.07.2009) page 1 line 8 - page 3 line 4 of the description, figure 1	1-1 1

1-1 Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 10 Jul. 2011(10.07.2011)	Date of mailing of the international search report 21 Jul. 2011 (21.07.2011)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer QI, Lin Telephone No. (86-10)62411295

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/CN201 1/073318

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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