(54) Title: ARTIFICIAL LEATHER AND THE METHOD FOR MANUFACTURING THE SAME

(57) Abstract: A fabric for artificial leather and a method having a nano fiber web on its surface are provided. The method for manufacturing the artificial leather includes laminating a substrate and a nano fiber web, and bonding the substrate and the nano fiber web to each other by performing a waterpunching process such that a fluid delivered into the laminated structure of the substrate and the nano fiber web. Natural leather like softness and texture can be obtained by imparting surface softness and texture to a surface of a nano fiber web while reinforcing physical properties of a substrate. In addition, a soft touch and texture similar to those of natural leather can be achieved by implementing a density gradient that is similar to that of natural leather. Further, artificial leather can be manufactured without locally uneven distribution.
[DESCRIPTION]

[Invention Title]

ARTIFICIAL LEATHER AND THE METHOD FOR MANUFACTURING THE SAME

[Technical Field]

The present invention relates to a fabric for artificial leather, and more particularly, to a fabric for artificial leather, which has a nano fiber web on its surface, thereby imparting excellent softness to the artificial leather, and a method for manufacturing the artificial leather.

[Background Art]

In general, numerous attempts have hitherto been made to obtain a texture like natural leather using microfine fibers. Specifically, methods of producing leather using sea-island type fibers or ultrafine fiber forming fibers are widely used.

For example, Korean Patent Registration No. 10-247080 entitled "Manufacturing Method of Artificial Leather with High Density, High Tenacity and Softness" discloses a manufacturing method of an artificial leather obtained by forming a three-layered sheet consisting of an island type ultrafine fiber, a polymer blending type ultrafine fiber forming fiber, and a reinforced fabric inserted therebetween, needle-punching the three-layered sheet and thermally shrinking the same to give foams, and then performing post-treatment. As another example, Korean Patent Application No. 10-2000-10656 entitled "Process for Preparing Base Fabric for Smooth Artificial Leather" discloses a process for preparing a base fabric for artificial leather, in which using a knitted fabric produced from ultrafine fiber forming yarn with an island type portion having a denier of 0.2 to 0.05 as a reinforcing substrate, impregnating the knitted fabric for ultrafine fiber formation treatment, and performing post-treatment.

According to the inventors, the artificial leather having excellent touch feel and flexibility can be manufactured using the methods of artificial leather proposed by the above disclosed inventions.

As a more advanced technology of manufacturing sea-island type
artificial leather, U.S. Patent No. 6,767,853 discloses a fibrous substrate for artificial leather, containing microfine fiber bundles, each of which is composed of 3-50 microfine fibers (A) containing an elastic polymer and having an average fineness of 0.5 denier or less and 15 or more microfine fibers (B) containing a non-elastic polymer and having an average fineness of 0.2 denier or less. According to the disclosed patent, since an island component of each microfine fiber bundle is an elastic polymer, the obtained artificial leather provides for a high-class feeling of softness and a natural leather-like appearance.

Despite such advantages stated above, the disclosed artificial leather still has several problems, for example, costly materials, complicated manufacturing processes, and so on.

Meanwhile, a nano fiber web is a web-like material having randomly distributed ultrafine fibers having a diameter in the range of from several tens to several hundreds of nanometers, as shown in FIG. 1. The nano fiber web is manufactured by electrospinning. Korea Patent No. 10-543489 discloses a manufacturing device and method of preparing for the nano fibers by electro-blown spinning process.

Although the conventional nano fiber web has a relatively soft surface like natural leather, it is considerably weak in terms of mechanical property, which limiting its applications.

[Disclosure]
[Technical Solution]

The present invention provides a fabric for artificial leather having a nano fiber web and a substrate laminated and securely bonded to each other.

The present invention also provides a method for manufacturing artificial leather, by which a nano fiber web and a substrate are easily bonded to each other, post-treatment of artificial leather can be simplified or skipped, and shortcomings of the nano fiber web can be canceled.

According to an aspect of the present invention, there is provided a fabric of artificial leather having a substrate and a nano fiber web
laminated, wherein the substrate and the nano fiber web are securely bonded to each other such that a portion of the nano fiber web is impregnated into the substrate by waterpunching.

According to another aspect of the present invention, there is provided a method for manufacturing artificial leather including laminating a substrate and a nano fiber web, and bonding the substrate and the nano fiber web to each other by performing a waterpunching process such that a fluid delivered into the laminated structure of the substrate and the nano fiber web.

In the laminating process, a multiple-ply stack of the nano fiber webs may be laminated. The substrate may be one selected from the group consisting of knitted fabric, woven fabric, short-fiber non-woven fabric, melt-blown, spunbond non-woven fabric, spun lace, and a nano fiber web, or a combination of two or more kinds of these fibers. The kind of the substrate selected is one of important factors in providing the mechanical strength and density gradient to the selected substrate.

The nano fiber web may be manufactured by electrospinning or the like. The nano fiber web manufactured by electrospinning preferably has an average diameter in a range of from 50 nm to 2,000 nm, more preferably 100 nm to 1,000 nm. The nano fiber web may be made of, but not limited to, thermoplastic resin, thermocurable resin, and any other material, so long as a synthetic resin is capable of being compatible with electrospinning. The nano fiber web may be at least one selected from the group consisting of polyamide, polyacrylonitrile, polycarbonate, polyurethane, polyimide, polyamidimide, polyethylene terephthalate, polyaniline, polyethyleneglycol, polyvinylalcohol, polyvinylidene fluoride, poly(L-lactic acid), polyglycol alginate, and copolymers or derivatives thereof.
Advantageous Effects]

As described above, according to the present invention, merits and characteristics of natural leather can be obtained by imparting surface softness and texture to a surface of a nano fiber web while reinforcing physical properties of a substrate. In addition, a soft touch and texture similar to those of natural leather can be achieved by implementing a density gradient that is similar to that of natural leather. Further, the present invention enables the manufacture of artificial leather without locally uneven distribution.

[Description of Drawings]

The above and other features and advantages of the present invention will become more apparent by describing in detail preferred embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a scanning electron micrograph (SEM) photograph illustrating an example of a general nano fiber web;

FIG. 2 is a conceptual diagram illustrating artificial leather according to an embodiment of the present invention;

FIG. 3 is a photograph illustrating a fabric for artificial leather according to an embodiment of the present invention;

FIG. 4 is a conceptual diagram illustrating a waterpunching apparatus for manufacturing the fabric for artificial leather shown in FIG. 4; and

FIGS. 5 through 9 are enlarged views illustrating cross sections of the artificial leather shown in FIG. 2 in various exemplary processes in a method for manufacturing the artificial leather.

[Mode for Invention]

Referring to FIG. 2, a fabric, i.e., a spunbond non-woven fabric 10, is used as a substrate for artificial leather according to an embodiment of the present invention. The spunbond non-woven fabric 10 and a nano fiber web 20 are laminated, and some of fibers forming the nano fiber web 20 are impregnated into the spunbond non-woven fabric 10.

In particular, the spunbond non-woven fabric 10, which is a splittable
type of fiber, according to the current embodiment is a long-fiber non-woven fabric manufactured by spinning a filament-like fiber.

The spunbond non-woven fabric 10 has a cross-section with orange-like multi-segments containing two or more components. Thus, when a physical pressure is applied after spinning or at least one component is eluted, fibers forming the nano fiber web 20 each having a fan-shaped cross-section are separated from one another.

The nano fiber web 20 has an average diameter of about 800 nm. In the present invention, no particular limitation is placed on the average diameter range of fibers forming a nano fiber web, so long as the nano fiber web can be manufactured within the average diameter range, but the invention is applicable to a nano fiber web composed of fibers having an average diameter in a range of from 50 nm to 5,000 nm.

The nano fiber web 20 having a diameter in a range of from 100 nm to 1,000 nm has a properties of the sense of soft touch incomparable to the sea-island type artificial leather. In this manner bond between the nano fiber web 20 having the specific diameter and the substrate enables to manufacture a fabric having both a specific sense of touch of the nano fiber web 20 and stiffness of the substrate.

The nano fiber web 20 cannot penetrate easily into the spunbond non-woven fabric 10 in case the diameter thereof is so large. And on the contrary in case of the diameter thereof is so small, the possibility of damage of the nano fiber web 20 by water pressure in the waterpunching process get higher. So it is desirable that the nano fiber web 20 has a diameter in the range of from 100 nm to 1000 nm.

Also, it is desirable that the nano fiber web 20 has a basis weight in a range of from 5 to 100 gsm. Below 5 gsm a specific sense of touch of the nano fiber by the waterpunching process is hard to be revealed, and above 100gsm a light and soft artificial leather is hard to be manufactured.

The spunbond non-woven fabric 10 and the nano fiber web 20 may have structures each composed of multiple-ply stacks, respectively. Here, the
spunbond non-woven fabric structure in which the multiple-ply stacks are sparsely spaced, and the nano fiber web structure in which the multiple-ply stacks are densely spaced, are laminated in a density-gradient fashion in a density ascending order from the nano fiber web 20 to the spunbond non-woven fabric 10, thereby implementing a density gradient that is similar to that of natural leather. Accordingly, the use of the aforementioned fabric in the manufacture of artificial leather enables achievement of a soft touch and texture similar to those of natural leather.

In an exemplary embodiment, a spunbond non-woven fabric and a meltblown fiber may be laminated in such a manner that the meltblown fiber having a higher density than the spunbond non-woven fabric is interposed between the spunbond non-woven fabric and the nano fiber web, thereby forming a density gradient in a sequential order of the nano fiber web, the meltblown fiber and the spunbond non-woven fabric.

FIG. 3 illustrating a fabric for artificial leather, in which a textile is used as a substrate, and a nano fiber web having an average diameter of about 400 nm is bonded to the fabric. The substrate and the nano fiber web are bonded to each other by waterpunching.

A process of manufacturing the fabric for artificial leather comprising the substrate and the nano fiber web will now be described. First, the substrate and the nano fiber web are laminated. In the laminating process, the substrate and the nano fiber web may be separately prefabricated to then be simply laminated. Alternatively, the nano fiber web may be directly spinned on the substrate. In this case, the nano fiber web and the substrate are bonded to each other, which is advantageous for facilitation of a subsequent process.

After the laminating process, the laminated substrate and the nano fiber web are transferred to a water jet to be subjected to waterpunching.

As shown in FIG. 4, a water jet device which has a plurality of water jets 2 according to the circumferential surface of an evacuated collector 1 emits a stream of water of a high pressure to the laminated structure
consisting of the substrate and the nano fiber web placed on a collector. The splittable spunbond non-woven fabric is well splitted by the high pressure.

In the waterpunching process, the high-pressure water streams are delivered from the nano fiber web to the substrate through water jets so that the nano fiber web penetrates into the substrate.

EXAMPLE

The invention will now be described by way of the following examples, but the invention is not limited thereto.

The spunbond non-woven fabric 10 is a splittable spunbond non-woven fabric web in which splittable microfine fibers are grafted to a filament-like spunbond structure. The spunbond non-woven fabric 10, which is composed of filament-like microfine fibers, is splitted by waterpunching preceded by a forming process of the splittable spunbond non-woven fabric web, and is a thin, lightweight fabric.

Table 1 shows conditions of waterpunching processes performed out in various examples.

The following examples were carried out in the same conditions using waterpunched products of nylon/PET as the spunbond non-woven fabric 10, nylon nano fiber products as the nano fiber web 20, the nylon nano fiber products having a fiber diameter of 400 and 800 nm and a basis weight of 30 gsm (g/m²), and knitted fabric, woven fabric, needle-punched non-woven fabric and the like as the substrate.

In addition, the examples were carried out with water jet pressures of 80 and 200 bar.

As shown in Table 1, in Example 4, the spunbond non-woven fabric 10 and the nano fiber web 20 are laminated such that the spunbond non-woven fabric 10 is interposed between nano fiber webs 20, and the resultant laminated structure was then waterpunched.

[Table 1]
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<tr>
<td>1</td>
<td>Knitted fabric</td>
<td>Up</td>
<td>1</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>2</td>
<td>Splittable non-woven fabric</td>
<td></td>
<td>1</td>
<td></td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>&quot;</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>&quot;</td>
<td>Up, Down</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>&quot;</td>
<td>Up</td>
<td>1</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Knitted fabric</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Prepunched non-woven fabric</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Woven fabric</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

FIGS. 5 through 9 are enlarged views illustrating cross sections of the artificial leather shown in FIG. 2 in various examples of the waterpunching process.

Referring to FIGS. 5 and 6, when high pressure water streams of 200 bar were continuously sprayed into target substrates, waterpunched marks were created, as indicated by arrows. That is, line patterns spaced a predetermined intervals apart from each other are formed by the waterpunching process.

FIG. 7 is an SEM photograph illustrating a surface of the artificial leather according to an example in which the artificial leather is waterpunched with high pressure water streams of 80 bar. As shown in FIG. 7, even if punching points are spaced a predetermined interval apart from one another, water marks are left on the surface due to discontinuous waterpunching processes. In addition, the non-woven fabric and the substrate are securely entangled.

Referring to FIG. 8, together with FIG. 2, the nano fibers 21 of the nano fiber web 20 penetrate into the spunbond non-woven fabric 10. That is to say, some of the nano fibers 21 forming the nano fiber web 20 push the surface of the spunbond non-woven fabric 10 due to a water pressure, intrusively penetrating into the spunbond non-woven fabric 10 in a wedge.
shape. The nano fibers 21 having intrusively penetrated into the spumbond non-woven fabric 10 provide for a strong bonding force to the microfine fiber structure.

FIG. 9 schematically illustrates that wedge-shaped nano fibers 21 having penetrated into the spumbond non-woven fabric 10.

As shown in Table 1, both the nano fiber web with a fiber diameter of 400 nm and the nano fiber web with a fiber diameter of 800 nm showed that they were efficiently entangled in a vertical direction by waterpunching without delamination.

<table>
<thead>
<tr>
<th>Example</th>
<th>Component</th>
<th>Maximum Pressure (bar)</th>
<th>Tensile strength (N/mm²)</th>
<th>Strain (%)</th>
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<tr>
<td>2</td>
<td>Nano fiber Web + Non-woven fabric</td>
<td>200</td>
<td>12.0</td>
<td>80.6</td>
</tr>
<tr>
<td>3</td>
<td>Nano fiber Web + Non-woven fabric waterpunched twice</td>
<td>200</td>
<td>13.2</td>
<td>101.1</td>
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</table>

As shown in Table 2, when comparing data for Example 2 in which waterpunching was performed once with data for Example 2 in which waterpunching was performed twice, the more frequently the waterpunching is performed, the higher the tensile characteristic, e.g., a tensile strength or a strain, becomes while exhibiting high entangling efficiency. This suggests that the entangling force, that is, the bonding strength, between the nano fiber web and the non-woven fabric can be increased by performing the waterpunching as many times as possible. with a higher strength, ultimately enhancing the tensile characteristic.

Next, the substrate useful in the present invention will be described.
<table>
<thead>
<tr>
<th>Example</th>
<th>Component</th>
<th>Maximum Pressure (bar)</th>
<th>Tensile strength (N/mm²)</th>
<th>Strain (%)</th>
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<tr>
<td>6</td>
<td>Nano fiber Web + Knitted fabric</td>
<td>80</td>
<td>42.9</td>
<td>27</td>
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<tr>
<td>8</td>
<td>Nano fiber Web + Woven fabric</td>
<td>80</td>
<td>18.1</td>
<td>59</td>
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Referring to Table 3, the tensile performance of artificial leather is sufficiently exhibited only with the spunbond non-woven fabric non-woven substrate with waterpunching treatment. The artificial leather of Example 6 having a knitted fabric and a nano fiber web had 4 times higher tensile performance than the artificial leather of Example 2 having a spunbond non-woven fabric and a nano fiber web. In addition, the artificial leather of Example 8 having a woven fabric and a nano fiber web had 2 times higher tensile performance than the artificial leather of Example 2. In addition to such mechanical benefits, the nano fiber web contained in the artificial leather according to the present invention provides various advantages, including a surface feeling like natural leather. As described above, the artificial leather optimized according to the purposes can be manufactured by employing the substrates having various properties and performance.

Table 4 demonstrates the results of a tensile strength test performed according to an embodiment of the present invention.

As to the standard used for measurement of the tensile strength of the nano fiber web, see "Paper and Board - Determination of tensile strength properties - Part 2: Constant rate of elongation method".

<table>
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<th>Item</th>
<th>Test Method</th>
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<tr>
<td>Specimen</td>
<td>15 × 250 mm rectangle</td>
</tr>
<tr>
<td>Interval between clamps</td>
<td>180 mm</td>
</tr>
<tr>
<td>Test speed</td>
<td>60 mm/min (20 × 200 mm/min)</td>
</tr>
<tr>
<td>Test times</td>
<td>3 times</td>
</tr>
</tbody>
</table>
Instron's 3343 Single Column Materials Testing System, Capacity 1 kN

According to the test results, the level of surface softness was highest in a case of using nano fibers only. The tensile performance of artificial leather is sufficiently exhibited only with the spunbond non-woven fabric non-woven substrate. The composite specimen composed of the substrate and the nano fiber web can satisfy both the surface softness and the tensile performance. In addition, the optimal artificial leather optimized according to the purposes can be manufactured by employing the substrates having various properties and performance.
[CLAIMS]

[Claim 1]

A fabric of artificial leather having a substrate and a nano fiber web laminated, wherein the substrate and the nano fiber web are bonded to each other such that a portion of the nano fiber web is impregnated into the substrate by waterpunching, wherein the substrate is one selected from the group consisting of knitted fabric, woven fabric, short-fiber non-woven fabric, and spunbond non-woven fabric, or a combination of two or more kinds of these fibers,

wherein the nano fiber web is entangled by fibers randomly distributed, the fibers having an average diameter in a range of from 100 nm to 1,000 nm and a basis weight in a range of from 5 to 100 gsm.

[Claim 2]

The fabric of claim 1, wherein the nano fiber web is at least one selected from the group consisting of: polyamide, polyacrylonitrile, polycarbonate, polyurethane, polyimide, polyamidimide, polyethylene terephthalate, polyaniline, polyethyleneoxide, polyvinylalcohol, polyvinylidene fluoride, poly(L-lactic acid), polyglycol alginate, and copolymers or derivatives thereof.

[Claim 3]

The fabric of claim 1, wherein the short-fiber non-woven fabric is a melt-blown fiber.

[Claim 4]

The fabric of claim 1, wherein the substrate is a splittable spunbond non-woven fabric.

[Claim 5]

The fabric of claim 1, further comprising a lower nano fiber web provided beneath the substrate and enabling waterpunching.

[Claim 6]

A method for manufacturing artificial leather comprising:

laminating a nano fiber web and a substrate which is one selected from
the group consisting of knitted fabric, woven fabric, short-fiber non-woven fabric, spunbond non-woven fabric; and

bonding the substrate and the nano fiber web to each other by performing a waterpunching process such that a fluid delivered into the laminated structure of the substrate and the nano fiber web.

[Claim 7]

The method of claim 6, a plurality of substrates having different densities are sequentially disposed in a density gradient fashion such that a higher density substrate is positioned near the nano fiber web.

[Claim 8]

The method of claim 7, wherein each of the substrates is composed of a spunbond non-woven fabric and a melt-blown web, and the melt-blown web is interposed between the nano fiber web and the spunbond non-woven fabric.

[Claim 9]

The method of claim 6, wherein the nano fiber web is entangled by fibers randomly distributed, the fibers having an average diameter in a range of from 100 nm to 1,000 nm and a basis weight in a range of from 5 to 100 gsm.

[Claim 10]

The method of claim 6, wherein the nano fiber web is at least one selected from the group consisting of: polyamid, polyacrylonitrile, polycarbonate, polyurethane, polyimide, polyamidimide, polyethylene terephthalate, polyaniline, polyethyleneoxide, polyvinylalcohol, polyvinylidene fluoride, poly(L-lactic acid), polyglycol alginate, and copolymers or derivatives thereof.

[Claim 11]

The method of claim 6, wherein the short-fiber non-woven fabric is a melt-blown fiber.

[Claim 12]

The method of claim 6, wherein the spunbond non-woven fabric is a splittable fiber.
[Claim 13]

The method of claim 6, further comprising a lower nano fiber web provided beneath the substrate and enabling waterpunching.
[Figure 5]

[Figure 6]
[Figure 9]
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

D04H 1/44(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 8: D04H 1/44

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

Korean utility models and applications for utility models since 1975

Japanese utility models and applications for utility models since 1975

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

eKIPASS(KIPO internal)

Keywords: artificial, web

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>WO 2005-078184 A1 (TORAY INDUSTRIES INC.) 25 August 2005&lt;br&gt;See claim 1 and claim 22</td>
<td>6, 10-12&lt;br&gt;1-5,7-9,13</td>
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<td>A</td>
<td>KR 10-2005-0058986 A (KURARAY CO., LTD.) 17 June 2005&lt;br&gt;See claim 1 and claim 6</td>
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<td>JP 2004-256983 A2 (TORAY INDUSTRIES INC.) 16 September 2004&lt;br&gt;See figure 5 and paragraph 45</td>
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☐ Further documents are listed in the continuation of Box C.  ☒ See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
- "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

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search

11 FEBRUARY 2008 (11.02.2008)

Date of mailing of the international search report

11 FEBRUARY 2008 (11.02.2008)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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Facsimile No. 82-42-472-7140

Authorized officer

KIM, KEON HYEONG

Telephone No. 82-42-481-5624

Form PCT/ISA/210 (second sheet) (April 2007)
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