

(19)



(11)

EP 2 873 756 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:

20.05.2015 Bulletin 2015/21

(51) Int Cl.:

D01F 8/12 (2006.01)(21) Application number: **13816284.7**

(86) International application number:

PCT/JP2013/069066(22) Date of filing: **11.07.2013**

(87) International publication number:

WO 2014/010709 (16.01.2014 Gazette 2014/03)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME

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(54) **SHEATH-CORE BICOMPONENT FIBRE**

(57) The present invention provides a conjugated fiber that has excellent moisture-absorption properties, excellent antistatic properties, and excellent cool feeling by contact as well as being less prone to troubles in a post process even in the case where the fiber is interknitted with polyurethane or polyethylene terephthalate. The conjugated fiber is a core-sheath conjugated fiber, including: a core portion; and a sheath portion, wherein the core portion is not exposed through the surface of the core-sheath conjugated fiber, the core portion is composed of a polyether block amide copolymer represented by Formula (1), the polyether block amide copolymer having a hard segment (in the following formula) composed of nylon 6, the sheath portion is composed of a nylon-6 resin, and the area ratio of the core portion to the sheath portion in a transverse section of the core-sheath conjugated fiber is 3/1 to 1/5.



[In formula (1), PA represents a polyamide unit (hard segment) ; PE represents a polyether unit (soft segment); and n represents the number of repeating units.]

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Description

TECHNICAL FIELD

[0001] The present invention relates to a sheath-core bicomponent fibre (core-sheath conjugated fiber) that has excellent moisture absorption properties, excellent antistatic properties, and excellent cool feeling by contact and is suitable for use in clothes.

BACKGROUND ART

[0002] Polyamide fibers and polyester fibers are highly tenacious and are easy to dye and process, and therefore are widely used in clothes. In particular, polyamide fibers, which have a soft texture and are more moisture-absorbent than other synthetic fibers, are often used in underwear. However, the moisture absorption properties of polyamide fibers are not as good as natural fibers such as cotton. Furthermore, polyamide fibers have problems in that they cause sweating and stickiness, as well as being prone to electrostatic charging and thus giving uncomfortable feelings.

[0003] Under such circumstances, there has been demand for a synthetic fiber that has excellent moisture absorbing/releasing properties for prevention of sweating and stickiness and has thus high antistatic properties and cool feeling by contact, mainly for use in underwear and sportswear.

[0004] Patent Document 1 discloses a partially-open type core-sheath conjugated fiber. The partially-open type core-sheath conjugated fiber includes a moisture-absorbent polymer, and the moisture-absorbent polymer is exposed through the surface of the fiber so that the partially-open type core-sheath conjugated fiber sufficiently demonstrates its moisture absorption properties, antistatic properties, and cool feeling by contact.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0005] Patent Document 1: WO 2008/123586

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] However, the partially-open type core-sheath conjugated fiber of Patent Document 1 has a problem in that it is not easy to spin and process because the moisture-absorbent polymer is exposed through the surface of the fiber.

[0007] Furthermore, Examples of Patent Document 1 disclose a partially-open type core-sheath conjugated fiber which has the core portion composed of a polyether block amide copolymer whose hard segment is nylon 12. This may cause troubles such as detachment of the core portion of the fiber or yellowing or hardening of a fabric, in a post process after the partially-open core-sheath conjugated fiber is interknitted or interwoven with polyurethane or polyethylene terephthalate.

[0008] In view of such circumstances, an object of the present invention is to solve such a problem and to provide a conjugated fiber that can be produced with high productivity and has excellent moisture absorption properties, excellent antistatic properties, and excellent cool feeling by contact, as well as being less prone to troubles in a post process even in the case where the fiber is interknitted with polyurethane or polyethylene terephthalate.

MEANS FOR SOLVING THE PROBLEMS

[0009] In order to attain the above object, the present invention mainly provides a core-sheath conjugated fiber, including: a core portion; and a sheath portion, wherein the core portion is not exposed through the surface of the core-sheath conjugated fiber, the core portion is composed of a polyether block amide copolymer represented by Formula (1), the polyether block amide copolymer having a hard segment composed of nylon 6, the sheath portion is composed of a nylon-6 resin, and the area ratio of the core portion to the sheath portion in a transverse section of the core-sheath conjugated fiber is 3/1 to 1/5.



[In Formula (1), PA represents a polyamide unit (hard segment) ; PE represents a polyether unit (soft segment); and n represents the number of repeating units.]

EFFECT OF THE INVENTION

[0010] A core-sheath conjugated fiber of the present invention, which has the core portion composed of a polyether block amide copolymer whose hard segment is nylon 6 and the sheath portion composed of a nylon-6 resin, can be produced with high efficiency. In addition, the core-sheath conjugated fiber is excellent in moisture absorption properties, antistatic properties, and cool feeling by contact, even though the core portion is not exposed through the surface of the fiber. Furthermore, it is possible to prevent troubles in a post process after the fiber is interknitted or interwoven with polyurethane or polyethylene terephthalate.

[0011] Furthermore, the conjugated fiber of the present invention can be made into a fabric that feels very comfortable to the touch. Therefore, the conjugated fiber can be widely used in the fields of clothes such as underwear, shirts, business suits, pantyhose, socks, hats, scarfs, work clothes, and sportswear, and bedding, as well as other products such as gloves, inner materials for shoes, inner materials for helmets, interior materials for vehicles, and interior materials for indoor use.

MODE FOR CARRYING OUT THE INVENTION

[0012] The following description discusses the present invention in detail.

[0013] The present invention provides a core-sheath conjugated fiber including a core portion and a sheath portion.

[0014] The core-sheath conjugated fiber of the present invention is configured such that, in a transverse section of the fiber, the core portion is not exposed through the surface of the fiber. The core portion may be constituted by a single core or multiple cores.

[0015] The core portion of the core-sheath conjugated fiber of the present invention contains a polyether block amide copolymer represented by Formula (1) below.



[In Formula (1), PA represents a polyamide unit (hard segment) ; PE represents a polyether unit (soft segment); and n represents the number of repeating units.]

[0016] The polyamide unit, which constitutes the hard segment of the polyether block amide copolymer of the present invention, is nylon 6.

[0017] Furthermore, the polyether unit of the polyether block amide copolymer of the present invention is, for example, a polyoxyalkylene unit, polyether diol, or the like. Particularly suitable polyether units are polyethylene glycol, polytetramethylene glycol, and the like.

[0018] The mass ratio of polyamide units to polyether units is preferably 99 : 1 to 5 : 95, more preferably 80 : 20 to 10 : 90. A polyether block amide copolymer containing polyamide units and polyether units at such a ratio can be used effectively.

[0019] On the other hand, the sheath portion of the core-sheath conjugated fiber of the present invention contains a nylon-6 resin.

[0020] Such a fiber, which has the core portion composed of a polyamide block copolymer whose hard segment is nylon 6 and the sheath portion composed of a nylon-6 resin, exhibits excellent moisture absorption properties, excellent antistatic properties, and excellent cool feeling by contact.

[0021] The nylon-6 resin has a relative viscosity of preferably 2.1 to 2.9, particularly preferably 2.1 to 2.6, in 95.7% sulfuric acid. In the case where the relative viscosity of the nylon-6 resin is within this range, the fiber is less prone to breakage and uneven core-to-sheath ratio when spun, and the quality of the spun yarn will be excellent.

[0022] In view of fiber strength, dye affinity, moisture absorption properties, antistatic properties, and cool feeling by

contact, the core-sheath conjugated fiber of the present invention is preferably configured such that the area ratio of the core portion to the sheath portion in a transverse section of the fiber is preferably 3/1 to 1/5, more preferably 1/1 to 1/3.

[0023] As has been described, the conjugated fiber of the present invention has a core portion composed of a polyether block amide copolymer whose hard segment is nylon 6 and a sheath portion composed of a nylon-6 resin, and has a transverse section in which the core portion is not exposed through the surface of the fiber. This makes it possible to keep good antistatic properties, good moisture absorption properties, and good cool feeling by contact, and also possible to achieve good productivity. It is also possible to prevent troubles such as detachment of the core portion and yellowing or hardening of a fabric during heat setting at 170°C to 200°C which is a post process carried out after the fiber is interknitted or interwoven with polyurethane, polyethylene terephthalate, or the like.

[0024] The thickness (total fineness) of the conjugated fiber of the present invention is not particularly limited. Mainly for the purpose of keeping good texture of a clothing material, the fineness of the conjugated fiber is preferably within the range of 1 dtex to 100 dtex. The single filament fineness of the conjugated fiber of the present invention is also not particularly limited, and is preferably within the range of 0.5 dtex to 50 dtex.

[0025] The strength of the conjugated fiber of the present invention is not particularly limited. For the fiber to be readily spun and processed and to readily pass through knitting and weaving processes, and for the purpose of keeping the tenacity of a fabric made from the fiber, the strength of the conjugated fiber is preferably not less than 2.0 cN/dtex, more preferably not less than 2.5 cN/dtex.

[0026] Furthermore, the conjugated fiber of the present invention may be in any form when made into a fabric. The conjugated fiber may be used in the form of a multifilament yarn, a monofilament yarn, staple fibers, or the like. Filaments may be in the form of a false-twist textured yarn, an air mixed yarn, a designed yarn such as a core spun yarn, or a covering yarn. Staple fibers may be made into a spun yarn.

[0027] Moreover, the conjugated fiber of the present invention may be made into a fabric of any form. A knitted fabric may be constructed with either weft knitting or warp knitting, or a modified version of such knitting. A woven fabric may be constructed with, for example, plain weave, twill weave, or satin weave, or a modified version of such weave, or may be Dobby weave, Jacquard weave, or the like. Alternatively, the conjugated fiber may be made into lace, non-woven fabric, or felt.

[0028] There is no particular limitation on the fabric weight, the gauge and the like of such a fabric. Furthermore, the conjugated fiber of the present invention may be used in an amount of 100% by mass or may be interknitted or interwoven with other fibers. The proportion of the conjugated fiber of the present invention is also not particularly limited. It is preferable that the conjugated fiber of the present invention be used in an amount of 20% to 100% by mass.

[0029] A fabric having such functions may be made into clothing such as underwear, sweater, shirt, or pantyhose, sportswear such as training wear, or materials of bedding such as a sheet or inner cotton. This makes such products have the functions.

[0030] The following description discusses an example of a method for producing a conjugated fiber of the present invention.

[0031] The conjugated fiber of the present invention can be produced with a usual conjugate melt spinning machine. The method is not limited to a particular kind, and may be, for example, a conventional method by which to take up undrawn yarn at a spinning rate of 400 m/min to 1800 m/min and then draw the yarn, a high-speed spinning method by which to take up yarn at a spinning rate of 2500 m/min to 5000 m/min, a spin drawing method by which to take up undrawn spun yarn while continuously drawing the yarn, or the like.

EXAMPLES

[0032] The following description discusses the present invention in detail with reference to Examples. It should be noted that the present invention is not intended to be limited to the following Examples.

[0033] The strength at break and the elongation at break of a fiber were found in accordance with JIS L 1013, with the use of an Autograph tensile tester AGS-1KNG available from Shimadzu Corporation. The strength at break and the elongation at break were measured when a sample fiber 20 cm in length, which was extended at a tension speed of 20 cm/min, was broken.

[0034] The relative viscosity in 95.7% sulfuric acid was found by: preparing a solution of 0.5 g of a nylon-6 resin in 50 ml of 95.7% sulfuric acid; allowing the solution to flow through an Ostwald viscometer at a constant temperature of 25°C; and dividing the time taken for the solution to flow through the Ostwald viscometer by the time taken for sulfuric acid to flow through the Ostwald viscometer.

Example 1

[0035] A core-sheath conjugated fiber in which the area ratio of a core portion to a sheath portion was 1 : 1 and the core portion was not exposed through the surface of the fiber was obtained by melt spinning. The core portion was made

from a polyether block amide copolymer (PEBAX MH1657 available from Arkema K.K.) whose hard segment is nylon 6 and whose soft segment is polyethylene glycol. The sheath portion was made from nylon 6 (1010J available from DSM N.V.) having a relative viscosity of 2.43 in 95.7% sulfuric acid solution. The fineness was 78 dtex, and the number of filaments was 24. The strength at break was 2.29 cN/dtex, and the elongation at break was 50.5%.

Example 2

[0036] A core-sheath conjugated fiber in which the area ratio of a core portion to a sheath portion was 1 : 2 and the core portion was not exposed through the surface of the fiber was obtained by melt spinning. The core portion was made from a polyether block amide copolymer (PEBAX MH1657 available from Arkema K.K.) whose hard segment is nylon 6 and whose soft segment is polyethylene glycol. The sheath portion was made from nylon 6 (1010J available from DSM N.V.) having a relative viscosity of 2.43 in 95.7% sulfuric acid. The fineness was 78 dtex, and the number of filaments was 24. The strength at break was 3.04 cN/dtex, and the elongation at break was 51.5%.

Example 3

[0037] A core-sheath conjugated fiber in which the area ratio of a core portion to a sheath portion was 1 : 3 and the core portion was not exposed through the surface of the fiber was obtained by melt spinning. The core portion was made from a polyether block amide copolymer (PEBAX MH1657 available from Arkema K.K.) whose hard segment is nylon 6 and whose soft segment is polyethylene glycol. The sheath portion was made from nylon 6 (1010J available from DSM N.V.) having a relative viscosity of 2.43 in 95.7% sulfuric acid. The fineness was 78 dtex, and the number of filaments was 24. The strength at break was 3.44 cN/dtex, and the elongation at break was 53.5%.

Comparative Example 1

[0038] A partially-open type core-sheath conjugated fiber in which the area ratio of a core portion to a sheath portion was 1 : 2 and the core portion was exposed through the surface of the fiber was obtained by melt spinning. The core portion was made from a polyether block amide copolymer (PEBAX MV1074 available from Arkema K.K.) whose hard segment is nylon 12 and whose soft segment is polyethylene glycol. The sheath portion was made from nylon 6 (1010J available from DSM N.V.) having a relative viscosity of 2.43 in 95.7% sulfuric acid. The fineness was 78 dtex, and the number of filaments was 24.

Comparative Example 2

[0039] A core-sheath conjugated fiber in which the area ratio of a core portion to a sheath portion was 1 : 2 and the core portion was not exposed through the surface of the fiber was obtained by melt spinning. The core portion was made from a polyether block amide copolymer (PEBAX MH1657 available from Arkema K.K.) whose hard segment is nylon 6 and whose soft segment is polyethylene glycol. The sheath portion was made from polyethylene terephthalate. The fineness was 84 dtex, and the number of filaments was 24.

Comparative Example 3

[0040] A single component fiber was melt-spun from nylon 6 (1010J available from DSM N.V.) having a relative viscosity of 2.43 in 95.7% sulfuric acid. The fineness was 78 dtex, and the number of filaments was 24.

[0041] The fibers obtained in Examples and the fibers obtained in Comparative Examples were knitted into tube fabrics with the use of a circular knitting machine. The obtained tube fabrics were used as samples for evaluation of various properties below. The properties were evaluated in the following manner.

1) Moisture absorption properties

[0042] Each tube fabric was absolutely dried with a vacuum dryer. After that, the weight W_0 of the fabric was measured, the equilibrium weight W_1 of the fabric at 25°C and 60% RH was measured, and the equilibrium weight W_2 of the fabric at 30°C and 98% RH was measured. The moisture absorption difference ΔMR (%) was found through the equation $(W_2 - W_1) \times 100 / W_0 = \Delta MR$ (%), and the differences were compared. Greater ΔMR means better moisture absorption properties.

2) Antistatic properties

[0043] Each tube fabric was measured for initial frictional electricity, by the method for measuring frictional electricity attenuation in accordance with JIS L 1094-1997 under the following conditions.

Frictional electricity measuring instrument: Electrostatic tester

Rubbing cloth: Wool

Rubbing direction: Vertical direction

Scouring treatment: Treated

Temperature and humidity: 22°C, 33%RH

3) Cool feeling by contact (q-max)

[0044] A fabric (a knitted fabric), which was obtained by circular knitting and thereafter was scoured, dried, and dyed, was used as a sample. The cool feeling by contact of the sample was measured using a measuring instrument Thermolabo II (available from KATO TECH CO., LTD.) in the following manner. BT-Box was adjusted to 38.7°C in a room having a temperature of 28.7°C and a humidity of 60% RH and was placed on the thoroughly conditioned sample (pressure: 10 g/cm²) so that the difference in temperature between the BT-Box and the sample was 10°C. The heat transfer rate per unit area was measured under these conditions. It is preferable that the fabric have a q-max of 0.150 (J/cm²-sec) or greater in this measurement.

4) Transmittance

[0045] Two tube fabrics were stacked together, and transmittance was measured with the use of a recording spectrophotometer (UV-3101PC) available from Shimadzu Corporation.

[0046] The results of evaluation on moisture absorption properties are shown in Table 1 below. The fibers of Examples 1 to 3 and the fibers of Comparative Examples 1 and 2 were found to be moisture-absorbent. In particular, the fibers of Examples 1 and 2 had a large ΔMR, which means that these fibers are highly moisture-absorbent.

[Table 1]

	ΔMR (%)
Example 1	10.1
Example 2	7.7
Example 3	5.0
Comparative Example 1	5.1
Comparative Example 2	4.3
Comparative Example 3	2.3

[0047] The results of evaluation on the antistatic properties of the fiber of Example 2 of the present invention and the fibers of Comparative Examples are shown in Table 2 below. The fiber of Comparative Example 3, which does not contain a polyether block amide copolymer, was found to be not antistatic. The fiber of Comparative Example 1, in which the hard segment of the core portion is nylon 12, and the fiber of Comparative Example 2, whose sheath portion is polyester, had good antistatic properties. In particular, the fiber of Example 2 of the present invention was highly antistatic.

[Table 2]

	Initial frictional electricity (V)
Example 2	1830
Comparative Example 1	3500
Comparative Example 2	-4660
Comparative Example 3	13800

[0048] The results of evaluation on the cool feeling by contact of the fiber of Example 2 of the present invention and

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the fibers of Comparative Examples are shown in Table 3. The fiber of Example 2 and the fiber of Comparative Example 1 were found to be cool by contact. In particular, the fiber of Example 2 of the present invention exhibited excellent cool feeling by contact.

[Table 3]

	q-max (J/cm ² ·sec)
Example 2	0.171
Comparative Example 1	0.156
Comparative Example 2	0.140
Comparative Example 3	0.134

[0049] The fiber of Example 2 of the present invention and the fiber of Comparative Example 3 were measured for transmittance in a near infrared region of 700 nm to 2400 nm. This region is related to thermal action. The mean of the measured transmittances is shown in Table 4. The fiber of Example 2 has a low transmittance as compared to the fiber of Comparative Example 3. That is, the fiber of Example 2 has good heat-shielding properties.

[Table 4]

	Average transmittance (%)
Example 2	13.1
Comparative Example 3	18.9

[0050] The fabrics were heat-treated for 1 minute at 190°C at which polyurethane and polyethylene terephthalate would be heat-set. After that, the appearance of the fabrics was checked. The results are shown in Table 5. If the fabric did not show any change, the fabric was evaluated as Good (O). If a polymer fallen off from the fabric and/or the fabric turned yellow, the fabric was evaluated as Poor (X).

[Table 5]

Example 1	○
Example 2	○
Example 3	○
Comparative Example 1	×
Comparative Example 2	○
Comparative Example 3	○

[0051] The fibers of Examples were compared with the fibers of Comparative Examples in terms of the occurrence of fiber breakage during fiber production. As a result, the fibers of Examples and the fiber of Comparative Example 3 were found to be less prone to breakage, whereas the fibers of Comparative Examples 1 and 2 were found to be more prone to breakage and have poor productivity. Furthermore, the fibers of Examples and the fibers of Comparative Examples were stored in the same cardboard box and the color tone of the fibers was checked after three months. As a result, only the fiber of Comparative Example 1 turned yellow.

[0052] Furthermore, the fibers of Examples all had no unevenness in core-to-sheath ratio and were high quality, whereas the fiber of Comparative Example 2 had unevenness in core-to-sheath ratio.

[0053] Furthermore, the fibers obtained in Examples 1 to 3 were dyed with an acid dye. As a result, the fibers had good dye affinity. Note that, when the conjugated fibers obtained in Examples 1 to 3 and the conjugated fibers obtained in Comparative Examples 1 to 3 were interknitted with polyurethane and thereafter heat-treated and processed, the polymers of the fabric knitted from the fiber of Comparative Example 1 fallen off and the fabric turned yellow, whereas the polymers of the fabric knitted from the fibers of Examples did not fall off and the fabrics did not turn yellow.

[0054] As is clear from above, the fibers of Examples are moisture-absorbent, antistatic, cool by contact and the fibers are less prone to troubles in a post process even in the case where the fibers are interknitted with polyurethane or polyethylene terephthalate. Furthermore, the fiber of Example 2 barely transmits near infrared wavelengths and has

good heat-shielding properties. Therefore, the fiber of Example 2 is also suitable for use in applications that require heat-shielding properties.

Claims

1. A core-sheath conjugated fiber, comprising:

a core portion; and

a sheath portion,

wherein the core portion is not exposed through a surface of the core-sheath conjugated fiber,

the core portion is composed of a polyether block amide copolymer represented by Formula (1), the polyether block amide copolymer having a hard segment composed of nylon 6,

the sheath portion is composed of a nylon-6 resin, and

an area ratio of the core portion to the sheath portion in a transverse section of the core-sheath conjugated fiber is 3/1 to 1/5.



[In Formula (1), PA represents a polyamide unit (hard segment); PE represents a polyether unit (soft segment); and n represents the number of repeating units.]

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/069066

A. CLASSIFICATION OF SUBJECT MATTER

D01F8/12 (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)

D01F8/00-8/18

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2013

Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2010-189772 A (Gunze Ltd.), 02 September 2010 (02.09.2010), paragraphs [0012], [0032], [0044] (Family: none)	1
A	JP 1-16926 B2 (Toray Industries, Inc.), 28 March 1989 (28.03.1989), example 1 & JP 61-258019 A	1
A	JP 61-289123 A (Toray Industries, Inc.), 19 December 1986 (19.12.1986), claims (Family: none)	1

☒ 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

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"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
21 August, 2013 (21.08.13)Date of mailing of the international search report
03 September, 2013 (03.09.13)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/069066

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/123586 A1 (KB Seiren, Ltd.), 16 October 2008 (16.10.2008), claims & EP 2130955 A1 claims & US 2010/0047572 A1 & CN 101652506 A & KR 10-2009-0127259 A & TW 200844282 A	1
A	WO 2010/038732 A1 (KB Seiren, Ltd.), 08 April 2010 (08.04.2010), claims & EP 2345754 A1 claims & US 2012/0128975 A1 & CN 102171390 A & KR 10-2011-0065532 A	1

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2008123586 A [0005]