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(54) Fibers and nonwovens with increased surface roughness.

(57) The present invention relates to fibers having an increased surface roughness. Further, the present invention relates to nonwovens, laminates and composites comprising such fibers. Additionally, the present invention relates to a process for producing such fibers, nonwovens, laminates and composites.

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Description

Field of the invention

[0001] The present invention relates to fibers having an increased surface roughness. Further, the present invention relates to nonwovens, laminates and composites comprising such fibers. Additionally, the present invention relates to a process for producing such fibers, nonwovens, laminates and composites.

The technical problem and the prior art

[0002] Polypropylene fibers are used in a wide range of applications, ranging from construction and agricultural industries over hygiene products, such as baby diapers, feminine hygiene products, adult incontinence products, or wipes, to medical applications, such as medical drapes and surgical gowns. In most of these applications polypropylene fibers are not used as such but rather in the form of nonwovens, which can be produced for example by thermal bonding of staple fibers, the spunbonding process, the melt blown process, or the spunlacing (hydroentanglement) process.

[0003] In order to be suitable for a specific application, the polypropylene therefore does not only need to have certain properties, such as mechanical properties, but also be adapted to a specific nonwoven-forming process. This is frequently done by applying spin finishes to the fibers either during or after their production. Alternatively, this can be done by blending the polypropylene with additives so that the additives are incorporated into the polypropylene and then migrate to the surface to give the desired functionality to the fiber.

[0004] A particular example of a transformation process that requires a spin finish is the spunlacing (hydroentanglement) process. In spunlacing polypropylene fibers are randomly distributed to form a nonconsolidated web, which is then consolidated using fine high-pressure water jets. Due to the action of the water jets a high percentage of the spin finish is lost to the process water, from which it then needs to be removed again for environmental reasons.

[0005] Further to adapting fibers for specific transformation processes, spin finishes are used to impart certain functionalities to the polypropylene fibers, for instance hydrophilic properties. Known polypropylene fibers have a smooth surface, and therefore do not easily retain spin finishes. Thus, much more spin finish than would be required to obtain the desired level of functionality needs to be applied.

[0006] In addition, and this is also the case for additives blended into the polypropylene, the functionality level that can be attained is limited by the surface area of the fibers. Thus, an increase in the fiber surface area would also allow an increased level of functionalities, such as hydrophilicity.

[0007] Thus, there is a need in the industry for polypropylene fibers, i.e. fibers comprising a polypropylene, that have improved retention of spin finishes.

[0008] There is also a need in the industry to provide polypropylene fibers with increased surface area.

[0009] Further, there is also a need in the industry to provide polypropylene fibers with an increased level of functionality.

[0010] Hence, it is an object of the present invention to provide polypropylene fibers having an increased surface roughness.

[0011] In addition, it is an object of the present invention to provide polypropylene fibers having an increased surface area.

[0012] Additionally, it is an object of the present invention to provide polypropylene fibers and nonwovens that can be produced easily.

[0013] It is a further object of the present invention to provide polypropylene fibers and nonwovens that have good properties, in particular good mechanical properties.

[0014] It is another object of the present invention to provide polypropylene fibers and nonwovens having an increased level of functionality, such as for example hydrophilicity.

[0015] Furthermore, it is an object of the present invention to provide polypropylene fibers that are better suited to some transformation process, in particular to the spunlacing process.

[0016] It is an even further object of the present invention to provide fibers having an increased bulkiness.

Brief description of the invention

[0017] We have now discovered that at least one of the above objectives can be met with the fibers of the present invention.

[0018] Thus, the present invention provides a multicomponent fiber comprising an interior component and an exterior component, wherein said exterior component covers at least 50 % of the surface of said fiber and comprises at least 70 wt% of a heterophasic propylene copolymer relative to the total weight of the exterior component, said heterophasic propylene copolymer comprising a propylene polymer matrix and a rubber..

[0019] In addition, the present invention provides nonwovens, laminates and composites comprising such fibers.

[0020] Further, the present invention provides a process for the production of such fibers, said process comprising the steps of

(a) providing a thermoplastic polymer to a first extruder,
(b) providing a polymer blend to a second extruder,
(c) melt-extruding the thermoplastic polymer of step (a) through a number of fine, usually circular, capillaries of a spinneret,
(d) melt-extruding the polymer blend of step (b) through a number of fine openings surrounding said capillaries of step (c), and
(e) combining the extrudates of steps (c) and (d) to form single fibers of an intermediate diameter, such that the extrudate of step (d) forms an exterior component covering at least 50 % of the surface of the fiber produced by combining the extrudates,

wherein the polymer blend of step (b) comprises at least 70 wt% of a heterophasic propylene, said heterophasic propylene copolymer comprising a propylene polymer matrix and a rubber..

Brief description of the drawings

[0021]

Figure 1 is a scanning electron microscope picture of the surface of bicomponent spunbond fibers with a heterophasic propylene copolymer as exterior component.
Figure 2 is a scanning electron microscope picture of the surface of monocomponent spunbond fibers made with a propylene homopolymer grade.

Detailed description of the invention

[0022] For the purpose of the present invention, the terms "fiber" and "filament" are used interchangeably.

[0023] The present invention provides a multicomponent fiber that comprises an interior component and an exterior component, wherein said exterior component covers at least 50 % of the surface of said multicomponent fiber, and wherein said exterior component comprises at least 70 wt% of a heterophasic propylene copolymer relative to the total weight of said exterior component.

[0024] Preferably, said exterior component covers at least 70 % of the surface of said multicomponent fiber, more preferably at least 90 %, even more preferably at least 95 %, still even more preferably at least 99 % and most preferably it covers the entire surface of the fiber.

[0025] Preferably, said exterior component comprises at least 80 wt%, more preferably at least 90 wt%, even more preferably at least 95 wt%, 97 wt% or 99 wt% relative to the total weight of the exterior component, and most preferably said exterior component consists of a heterophasic propylene copolymer. In addition to the heterophasic propylene copolymer the exterior component may comprise additives or thermoplastic polymers that are miscible with the heterophasic propylene copolymer, such as for example propylene homopolymer or propylene random copolymer.

[0026] The polymer that is used in the interior component is not especially limited. It is, however, preferred that it is a thermoplastic polymer, more preferred that it is a polyolefin, and most preferred that it is a polypropylene.

[0027] The heterophasic propylene copolymer used in the present invention comprises a propylene polymer matrix and a rubber. Because the propylene polymer matrix and the rubber are immiscible, the heterophasic propylene copolymer used in the present invention is characterized by at least two distinct phases, with rubber particles dispersed within the propylene polymer matrix.

[0028] The heterophasic propylene copolymer has a melt flow index in the range from 5 dg/min to 2000 dg/min as measured according to ISO 1133, condition L, at 230°C and 2.16 kg. When used for fiber spinning the melt flow index of the heterophasic propylene copolymer is in the range from 5 dg/min to 40 dg/min. When used in the spunbonding process the melt flow index of the heterophasic propylene copolymer is at least 10 dg/min, preferably at least 15 dg/min, and most preferably at least 20 dg/min. When used in the spunbonding process the melt flow index of the heterophasic propylene copolymer is at most 300 dg/min, preferably at most 200 dg/min, more preferably at most 150 dg/min, even more preferably at most 100 dg/min, and most preferably at most 60 dg/min. When used in the melt blown process the melt flow index of the heterophasic propylene copolymer is at least 100 dg/min, preferably at least 150 dg/min, more preferably at least 200 dg/min, even more preferably at least 250 dg/min, and most preferably at least 300 dg/min. When used in the melt blown process the melt flow index of the heterophasic propylene copolymer is at most 2000 dg/min, more preferably at most 1800 dg/min or 1600 dg/min, even more preferably at most 1400 dg/min or 1200 dg/min, and most preferably at most 1000 dg/min.

[0029] Preferably, the heterophasic propylene copolymer used in the present invention has a molecular weight distribution M_w/M_n of at least 3.5, more preferably of at least 4.0, even more preferably of at least 4.1, 4.2, 4.3 or 4.4, and most preferably of at least 4.5. Preferably, the molecular weight distribution M_w/M_n is at most 8.0, more preferably at most 7.5 or 7.0, even more preferably at most 6.5 and most preferably at most 6.0. The molecular weights and the molecular weight distribution can be determined by size exclusion chromatography (SEC) as described in more detail in the examples.

[0030] When the molecular weight distribution M_w/M_n of the heterophasic propylene copolymer is too broad, such as is generally the case for polypropylene obtained with a Ziegler-Natta catalyst, it may be narrowed by chemical or thermal degradation from a starting melt flow index MFI_1 to a final melt flow index MFI_2 (measured according to ISO 1133, condition L, 230°C, 2.16 kg). Chemical degradation (visbreaking) is preferred. For chemical degradation the propylene polymer is brought into intimate contact with a peroxide (e.g. 2,5-dimethylhexane-2,5-di-tertbutylperoxide) at an elevated temperature, thus leading to the generation of radicals which in turn lead to a breakdown of the polymer chains. In consequence, the melt flow index of the propylene polymer increases. Without wishing to be bound by theory, it is thought that the radicals preferentially attack the longer polymer chains for statistical reasons, the molecular weight distribution narrows. Visbreaking of propylene polymers is usually carried out at temperatures in the range from 200°C to 250°C. It can for example be done in the extruder in the granulation step of a propylene polymer manufacturing plant.

[0031] Preferably, the propylene polymer matrix of the heterophasic propylene copolymers of the present invention comprises a propylene homopolymer or a random copolymer of propylene and at least one further olefin different from propylene.

[0032] In case of a random copolymer said further olefin is preferably present in up to 4.0 wt% relative to the total weight of the random copolymer. More preferably it is present in up to 3.5 wt%, even more preferably in up to 3.0 wt%, still even more preferably in up to 2.5 wt% and most preferably in up to 2.0 wt% relative to the total weight of the random copolymer. Said further olefin is an α-olefin. It may for example be ethylene, 1-butene, 1-pentene, 4-methyl-1-pentene, 1-hexene, or 1-octene, of which ethylene and 1-butene are preferred, with ethylene being the most preferred.

[0033] The preferred propylene polymer matrix is a propylene homopolymer.

[0034] It is preferred that the propylene polymer matrix has a tacticity of more than 95.0 % of mmmm pentads. The percentage of mmmm pentads is determined on the insoluble heptane fraction of the xylene soluble fraction according to the method described by G.J. Ray et al. in Macromolecules, vol. 10, n° 4, 1977, p. 773-778). More preferably the tacticity is more than 96.0 %, even more preferably more than 97.0 %, and most preferably more than 98.0 %. In other words, it is preferred that the propylene polymer matrix is comprised of a propylene polymer that is predominantly isotactic.

[0035] If the propylene polymer matrix is a propylene homopolymer it is preferred that its xylene solubles content is at most 2.5 wt% and most preferably at most 2.0 wt%, relative to the total weight of the propylene homopolymer. The xylene solubles content is determined by dissolving the polypropylene in refluxing xylene, cooling of the solution to 25°C, filtering the solution, and subsequent evaporation of the solvent. The residue, which is the xylene soluble portion of the polypropylene, is then dried and weighed.

[0036] The rubber of the heterophasic propylene copolymer of the present invention comprises a first olefin, which is different from propylene, and a second olefin, which is different from the first olefin. Preferably, said first and second olefin are independently selected from the group consisting of ethylene and α-olefins. Specific examples for α-olefins that may be used are ethylene, propylene, 1-butene, 1-pentene, 4-methyl-1-pentene, 1-hexene, and 1-octene. As first olefin ethylene and butene are more preferred, with ethylene being most preferred. It is most preferred that the second olefin is propylene. Thus, the most preferred rubber is an ethylene-propylene rubber (EPR).

[0037] It is preferred that the first olefin is present in an amount of from 2.0 wt% to 20.0 wt% relative to the total weight of the heterophasic propylene copolymer, more preferably from 4.0 wt% to 16.0 wt%, even more preferably from 5.0 wt% to 15.0 wt% and most preferably from 7.0 wt% to 13.0 wt%.

[0038] For the present invention it is preferred that the rubber is present in an amount from 8.0 wt% to 24.0 wt%, more preferably from 10.0 wt% to 22.0 wt%, and most preferably from 14.0 wt% to 18.0 wt% relative to the total weight of the heterophasic propylene copolymer.*)*

[0039] Preferably, the propylene polymer matrix and the rubber, when taken together, comprise at least 90.0 wt% of the heterophasic propylene copolymer. More preferably, they comprise at least 95.0 wt% or 97.0 wt% or 99.0 wt%, even more preferably at least 99.5 wt% of the heterophasic propylene copolymer.

[0040] It has been found that the bicomponent fibers of the present invention are characterized by an increased surface roughness as compared to conventional polypropylene fibers made with for example a propylene homopolymer. A comparison is shown in **figure 1** and **figure 2**. **Figure 1** shows bicomponent fibers according to the present invention, i.e. having an exterior component comprising a heterophasic propylene copolymer, **figure 2** shows fibers made from a propylene homopolymer. It can be clearly seen that the bicomponent fibers of **figure 1** have increased surface roughness and also an increased surface area.

[0041] Though the sizes of the protruding surface parts are very small in comparison to the fiber diameter it has been surprisingly found that such a small difference is already sufficient in reducing the layer-to-layer slipping of such fibers.

This means that the nonwoven comprising such fibers will have improved properties as compared to a nonwoven made with polypropylene fibers having a smooth surface.

[0042] The heterophasic propylene copolymers used in the present invention may also comprise additives, such as for example antioxidants, light stabilizers, acid scavengers, lubricants, antistatic agents, fillers, nucleating agents, clarifying agents, colorants. An overview of useful additives is given in Plastics Additives Handbook, ed. H. Zweifel, 5th edition, Hanser Publishers.

[0043] The heterophasic propylene copolymers used in the present invention are produced either by physical or chemical blending. In physical blending a propylene polymer matrix and a rubber, which have been produced independently from one another, are blended together, for example in an extruder. In chemical blending, which is the preferred method, the propylene polymer matrix and the rubber are produced sequentially in at least two polymerization reactors in presence of a polymerization catalyst, usually a Ziegler-Natta or a metallocene-based polymerization catalyst, with Ziegler-Natta polymerization catalysts being preferred. Typically, the rubber is produced in a gas-phase polymerization reactor. These production methods are well known to the person skilled in the art and need not be described in more detail.

[0044] The fiber of the present invention is a multicomponent fiber. Preferably it is a bicomponent fiber. Bi- or multi-component fibers or filaments are known in many different configurations, such as for example side-by-side, sheath-core, islands-in-the-sea, pie or stripe configurations. Bi- or multi-component fibers can be formed by co-extrusion of at least two different components into one fiber or filament. This is done by feeding the different components to a corresponding number of extruders and combining the different melts into a single fiber. The resulting fiber or filament has at least two different essentially continuous polymer phases. Such fibers or filaments, their production as well as their forming a nonwoven are well known to the skilled person and are for example described in F. Fourné, Synthetische Fasern, Carl Hanser Verlag, 1995, chapter 5.2 or in B.C. Goswami et al., Textile Yarns, John Wiley & Sons, 1977, p. 371 - 376.

[0045] Generally fibers are produced by melting the polymer in an extruder, optionally passing the molten polymer through a melt pump to ensure a constant feeding rate and then extruding the molten polymer through a number of fine capillaries of a spinneret to form fibers. These still molten fibers are simultaneously cooled by air, drawn to an intermediate diameter and collected. They are for example collected on a winder or other suitable collecting means.

[0046] Thus, the process for their production of the bicomponent fibers of the present invention comprises the steps of

(a) providing a thermoplastic polymer to a first extruder,
(b) providing a polymer blend to a second extruder,
(c) melt-extruding the thermoplastic polymer of step (a) through a number of fine, usually circular, capillaries of a spinneret,
(d) melt-extruding the polymer blend of step (b) through a number of fine openings surrounding said capillaries of step (c), and
(e) combining the extrudates of steps (c) and (d) to form single fibers of an intermediate diameter, such that the extrudate of step (d) forms an exterior component covering at least 50 % of the surface of the fiber produced by combining the extrudates,
wherein the polymer blend of step (b) comprises at least 70 wt% of a heterophasic propylene copolymer as defined above.

Preferably the extrudate of step (d) forms an exterior component covering at least at least 70 %, more preferably at least 90 %, even more preferably at least 95 % or 99 % of the surface of the fiber, and most preferably it covers the entire surface of the fiber.

Preferably, said exterior component comprises at least 80 wt%, more preferably at least 90 wt%, even more preferably at least 95 wt%, 97 wt% or 99 wt% and most preferably consists of a heterophasic propylene copolymer. In addition to the heterophasic propylene copolymer the exterior component may comprise additives or thermoplastic polymers that are miscible with the heterophasic propylene copolymer, such as for example propylene homopolymer or propylene random copolymer.

Optionally, the single filaments of an intermediate diameter, which are obtained in step (e) may be drawn to a final diameter, i.e. the process for the production of the multicomponent fibers of the present invention further comprises the step of

(f) rapidly reducing the intermediate diameter of the fibers obtained in step (e) to a final diameter.

The nonwovens of the present invention may be produced by any suitable method. Such methods include thermal bonding of staple fibers, the spunlacing process, the spunbonding process and the melt blown process. The preferred methods are the spunlacing process, the spunbonding process and the melt blown process. Of these the spunlacing process and the spunbonding process are the more preferred ones, and the spunbonding process is the most preferred one.

For the production of nonwovens comprising the bicomponent fibers of the present invention the process further comprises the steps of

(g) collecting the fibers obtained in step (e) or step (f) on a support, and
(h) subsequently bonding the collected fibers to form a bonded nonwoven.

[0047] For the production of thermally bonded nonwovens the bicomponent fibers of the present invention are cut into staple fibers having a length in the range from 5 to 30 mm. Said staple fibers are then carded, i.e. collected as a more or less continuous non-consolidated web on a support. In a final step the non-consolidated web is consolidated by thermal or chemical bonding, with thermal bonding being preferred.

[0048] In the spunlacing process continuous fibers or staple fibers are distributed randomly a support to form a non-consolidated web, which is then consolidated by means of fine high-pressure water jets and dried.

[0049] In the spunbonding process a thermoplastic polymer is melted in a first extruder, optionally passed through a melt pump to ensure a constant feeding rate and then extruded through a number of fine, usually circular capillaries of a spinneret. In parallel a polymer blend comprising at least 70 wt% of a heterophasic propylene copolymer as defined above is melted in a second extruder, optionally passed through a melt pump and then extruded through a number of fine openings surrounding the fine, usually circular capillaries of the spinneret. The extrudates of the molten thermoplastic polymer and the molten polymer blend are combined to form a single - essentially still molten - filament of an intermediate diameter. The filament formation can either be done by using one single spinneret with a large number of holes, generally several thousand, or by using several smaller spinnerets with a correspondingly lower number of holes per spinneret. After exiting from the spinneret, the still molten filaments are quenched by a current of air. The diameter of the filaments is then quickly reduced by a flow of high-pressure air. Air velocities in this drawdown step can range up to several thousand meters per minute. After drawdown the filaments are collected on a support, for example a forming wire or a porous forming belt, thus first forming an unbonded web, which is then passed through compaction rolls and finally through a bonding step. Bonding of the fabric may be accomplished by thermobonding, hydroentanglement, needle punching, or chemical bonding.

[0050] In the melt blown process a thermoplastic polymer is melted in a first extruder, optionally passed through a melt pump to ensure a constant feeding rate and then extruded through a number of fine, usually circular capillaries of a special melt blowing die. In parallel a polymer blend comprising at least 70 wt% of a heterophasic propylene copolymer as defined above is melted in a second extruder, optionally passed through a melt pump and then extruded through a number of fine openings surrounding the fine, usually circular capillaries of the special melt blowing die. The extrudates of the molten thermoplastic polymer and the molten polymer blend are combined to form a single - essentially still molten - filament of an intermediate diameter. Usually melt blown dies have a single line of capillaries through which the molten polymer passes. After exiting from the die, the still molten filaments are contacted with hot air at high speed, which rapidly draws the fibers and, in combination with cool air, solidifies the filaments. In the following, the nonwoven is formed by depositing the filaments directly onto a forming wire or a porous forming belt.

[0051] Composites may be formed from two or more nonwovens, of which at least one is made in accordance with the present invention. In particular, the composites comprise a spunbond nonwoven layer (S) according to the present invention or a melt blown nonwoven layer (M) according to the present invention. Composites in accordance with the present invention can for example be SS, SSS, SMS, SMMSS or any other combination of spunbond and melt blown nonwoven layers.

[0052] The advantages of the increased surface roughness are particularly noticed in composites comprising the bicomponent fibers of the present invention because the nonwoven layers have a reduced tendency to displacement against one another. Hence, the overall mechanical properties of such a composite are improved.

[0053] A first nonwoven or composite, said first nonwoven or composite being in accordance with the present invention, and a film may be combined to form a laminate. The film preferably is a polyolefin film. The laminate is formed by bringing the first nonwoven or composite and the film together and laminating them to one another for example by passing them through a pair of lamination rolls. The laminates may further include a second nonwoven or composite, which can be but need not be according to the present invention, on the face of the film opposite to that of the first nonwoven or composite. In a preferred embodiment, the film of the laminate is a breathable polyolefin film, thus resulting in a laminate with breathable properties.

[0054] Thus, the laminates may be formed by laminating a film to the bonded nonwoven obtained in step (h). A composite may be formed by applying a nonwoven to the bonded nonwoven obtained in step (h).

[0055] The polypropylene fibers and filaments of the present invention can be used in carpets, woven textiles, and nonwovens.

[0056] The polypropylene spunbond nonwovens of the present invention as well as composites or laminates comprising it can be used for hygiene and sanitary products, such as for example diapers, feminine hygiene products and incontinence products, products for construction and agricultural applications, medical drapes and gowns, protective wear, lab coats, wipes, for example in sanitary but also in industrial applications, etc.

[0057] The polypropylene meltblown nonwovens of the present invention can be used in hygiene, filtration and absorption applications, such as diapers, feminine hygiene products, incontinence products, wraps, gowns, masks, filters, absorption pads etc. Frequently polypropylene meltblown nonwovens are used in combination with other nonwovens, such as for example spunbond nonwoven to form composites, which in turn may be used in the cited applications.

Examples

[0058] The melt flow index was measured according to ISO 1133, condition L, at 230°C and 2.16 kg.

[0059] Molecular weights are determined by Size Exclusion Chromatography (SEC) at high temperature (145°C). A 10 mg PP sample is dissolved at 160°C in 10 ml of TCB (technical grade) for 1 hour. The analytical conditions for the Alliance GPCV 2000 from WATERS are :

- Volume : +/- 400µl
- Injector temperature : 140°C
- Column and detector: 145°C
- Column set: 2 Shodex AT-806MS and 1 Styragel HT6E
- Flow rate 1ml/min
- Detector: Refractive index
- Calibration : Narrow standards of polystyrene
- Calculation : Based on Mark-Houwink relation ($\log(M_{PP}) = \log(M_{PS}) - 0.25323$)

[0060] Fiber titers were measured on a Zweigle vibroscope S151/2 in accordance with norm ISO 1973:1995.

[0061] Tensile strength and elongation of the nonwovens were measured according to ISO 9073-3:1989.

BASE MATERIALS

[0062] Fibers and nonwovens were produced using a commercial polypropylene homopolymer spunbond grade, denoted as PP1, and a heterophasic propylene copolymer, denoted as PP2, which was chemically degraded such that it had a final melt flow index (MFI) of 28 dg/min and a molecular weight distribution M_w/M_n of 4.7. The properties of PP1 and PP2 are shown in table 1.

Table 1

		PP1	PP2
MFI	dg/min	25	28.1
M_n	kDa	46	36
M_w	kDa	189	171
M_z	kDa	452	674
$MWD = M_w / M_n$		4.1	4.7

SPUNBOND NONWOVEN

[0063] Polypropylenes PP1 and PP2 were used to produce the following spunbond nonwovens

Example 1 -	Bicomponent nonwoven with PP1 as interior component and PP2 as exterior component wherein the exterior layer comprised 30 wt% of the total weight of the fibers
Comparative example 1 -	Nonwoven made from PP1

[0064] The spunbond nonwovens were produced on a 1.1 m wide Reicofil 4 line with a single beam having about 6800 holes per meter length, the holes having a diameter of 0.6 mm. The nonwoven had a fabric weight of 12 g/m^2. The nonwoven were thermally bonded using an embossed roll. Further processing conditions are given in table 2. The bonding roll temperature reported in table 2 is the bonding temperature at which the highest values for elongation were obtained. Properties of the nonwoven obtained under these conditions are shown in table 3.

Table 2

		Ex. 1	Comp. ex. 1
Belt speed	m/min	300	300
Throughput	Kg/h/m	220	220
Melt temperature at the die			
- Exterior component	°C	250	250
- Interior component	°C	250	n.a.
Cabin pressure	Pa	8000	8000
Nip pressure	N/mm	80	80
Calender temperature (set point) for max. elongation	°C	135	141

Table 4

		Ex. 1	Comp. ex. 1
Filament titer	den	1.0	1.1
Tensile strength @ max MD	N/5cm	20.4	31.5
Tensile strength @ max CD	N/5cm	11.8	17.1
Elongation MD	%	64	68
Elongation CD	%	73	71

[0065] The results obtained on the spunbond nonwovens of example 1 and comparative example 1 show that the nonwovens made in accordance with the present invention are characterized by acceptable tensile strengths in both, machine and cross-machine direction, and also have elongational properties in machine and cross-machine direction that are comparable to the ones obtained with a commercial propylene homopolymer spunbond grade.

[0066] **Figure 1** and **figure 2** show a scanning electron microscope picture of the fibers of example 1 and comparative example 1. In **figure 2** it can be seen that the monocomponent fibers of comparative example 1 have a very smooth surface, which does not well hold on to any additives or spin finishes. By contrast **figure 1** shows the bicomponent fibers of example 1, i.e. in accordance with the present invention. It can be seen that the heterophasic propylene copolymer, which forms the exterior component, gives rise to a very rough surface, which allows better retention of any additive or spin finish.

[0067] It has been found that the rougher surface of the bicomponent fibers of the present invention, as depicted in **figure 1**, reduces the layer-to-layer slipping in a nonwoven. In other words, the tendency of the fibers to disengage from one another in a nonwoven, which was for example produced by hydroentanglement, is much reduced. Thus, a hydroentangled nonwoven produced with the bicomponent fibers of the present invention has improved mechanical properties.

[0068] Further, the bicomponent fibers of the present invention, as shown in figure 1, are characterized by an increased surface area. They allow therefore to an increased level of functionalities, such as for example hydrophilicity. Without wishing to be bound by theory it is believed that the uneven surface and the increased surface area allow a higher number of functionality-imparting molecules to be present on the fiber surface, thus rendering the fiber for example more hydrophilic.

[0069] Due to the increased surface roughness and the protruding elements the bicomponent fibers of the present invention are also expected to increase the fiber bulkiness, which is of advantage for bulk continuous filaments (BCF).

Claims

1. Multicomponent fiber comprising an interior component and an exterior component, wherein said exterior component covers at least 50 % of the surface of said fiber and comprises at least 70 wt% of a heterophasic propylene copolymer relative to the total weight of the exterior component, said heterophasic propylene copolymer comprising a propylene polymer matrix and a rubber.

2. Multicomponent fiber according to claim 1, wherein the heterophasic propylene copolymer comprises a propylene polymer matrix and a rubber, said rubber comprising a first olefin, which is different from propylene, and a second olefin, which is different from the first olefin, said first olefin being present in an amount of from 2.0 wt% to 20.0 wt% relative to the total weight of the heterophasic propylene copolymer.

3. Multicomponent fiber according to any of the preceding claims, wherein the heterophasic propylene copolymer is an ethylene-propylene rubber.

4. Multicomponent fiber according to any of the preceding claims, wherein the rubber is present in an amount from 10.0 wt% to 22.0 wt% relative to the total weight of the heterophasic propylene copolymer.

5. Nonwoven comprising the bicomponent fibers of any of claims 1 to 4.

6. Laminate or composite comprising the bicomponent fibers of any of claims 1 to 4.

7. Process for the production of the bicomponent fiber of any of claims 1 to 4, comprising the steps of

(a) providing a thermoplastic polymer to a first extruder,
(b) providing a polymer blend to a second extruder,
(c) melt-extruding the thermoplastic polymer of step (a) through a number of fine, usually circular, capillaries of a spinneret,
(d) melt-extruding the polymer blend of step (b) through a number of fine openings surrounding said capillaries of step (c), and
(e) combining the extrudates of steps (c) and (d) to form single fibers of an intermediate diameter, such that the extrudate of step (d) forms an exterior component covering at least 50 % of the surface of the fiber produced by combining the extrudates,
wherein the polymer blend of step (b) comprises at least 70 wt% of a heterophasic propylene, said heterophasic propylene copolymer comprising a propylene polymer matrix and a rubber.

8. Multicomponent fiber according to claim 7, wherein the heterophasic propylene copolymer comprises a propylene polymer matrix and a rubber, said rubber comprising a first olefin, which is different from propylene, and a second olefin, which is different from the first olefin, said first olefin being present in an amount of from 2.0 wt% to 20.0 wt% relative to the total weight of the heterophasic propylene copolymer.

9. Multicomponent fiber according to claim 7 or claim 8, wherein the heterophasic propylene copolymer is an ethylene-propylene rubber.

10. Multicomponent fiber according to any of claims 7 to 9, wherein the rubber is present in an amount from 8.0 wt% to 24.0 wt% relative to the total weight of the heterophasic propylene copolymer.

11. Process according to any of claims 7 to 10, wherein the process further comprises the step of

(f) rapidly reducing the intermediate diameter of the fiber extruded in step (e) to a final diameter.

12. Process according to any of claims 7 to 11, wherein the process further comprises the steps of

(g) collecting the fibers obtained in step (e) or step (f) on a support, and
(h) subsequently bonding the collected fibers to form a bonded nonwoven.

13. Process according to any of claims 7 to 12, wherein the bonded nonwoven is a spunbond nonwoven or a spunlaced nonwoven

Figure 1

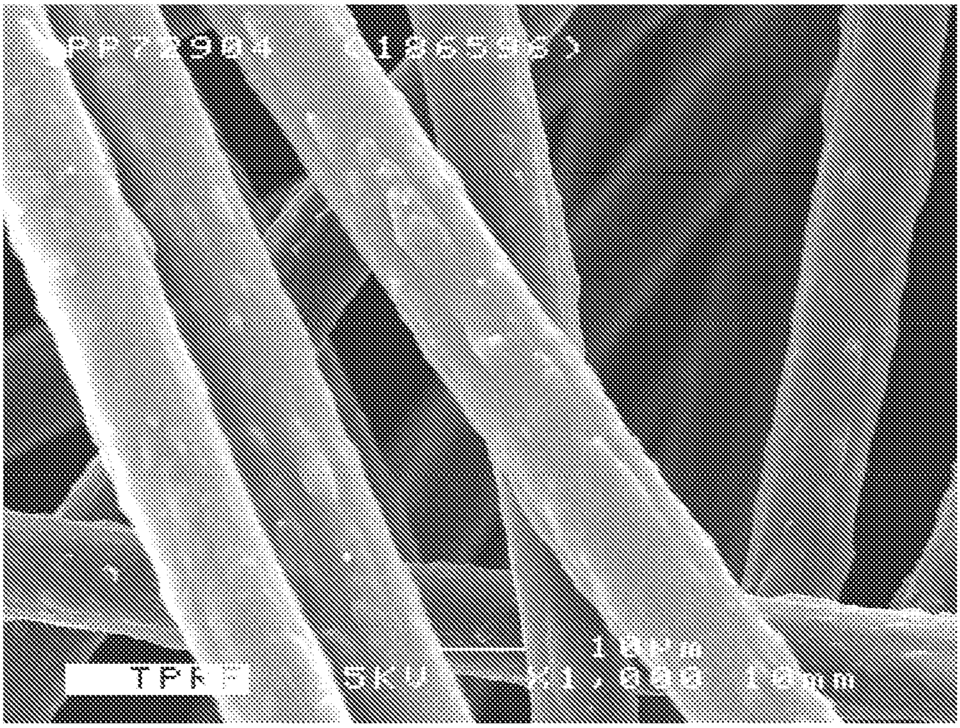
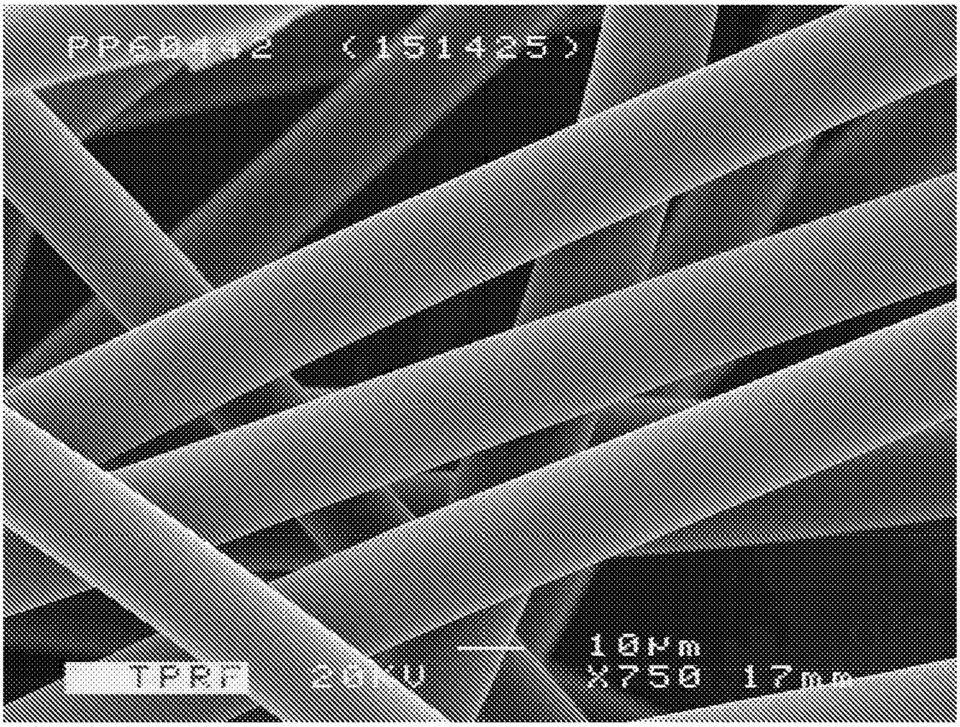


Figure 2



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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 1651

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 604 736 A (KIMBERLY CLARK CO [US]) 6 July 1994 (1994-07-06) * page 4, line 34 - line 45 * * page 5, line 12 - line 22 * * figures 1,2B,2C; examples 1-6 * -----	1-13	INV. D01F8/06
X	WO 2007/071496 A (BASELL POLIOLEFINE SRL [IT]; SARTORI GABRIELLA [IT]; SARTORI FRANCO [I) 28 June 2007 (2007-06-28) * abstract * * claim 6 * * examples 6,7 * -----	1-13	
A	EP 1 452 630 A (BOREALIS TECH OY [FI]) 1 September 2004 (2004-09-01) * page 2, line 50 - page 4, line 39 * * abstract * -----	1-13	
A	US 5 900 306 A (STOPPER STEVEN RAY [US]) 4 May 1999 (1999-05-04) * column 9, line 26 - line 47 * -----	1-13	TECHNICAL FIELDS SEARCHED (IPC) D01F D01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	29 January 2009	Malik, Jan

CATEGORY OF CITED DOCUMENTS

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....
& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 16 1651

29-01-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0604736 A	06-07-1994	AU 670634 B2	25-07-1996
		AU 5057893 A	07-07-1994
		BR 9305184 A	05-07-1994
		CA 2094307 A1	29-06-1994
		DE 69330115 D1	17-05-2001
		DE 69330115 T2	16-08-2001
		JP 6257017 A	13-09-1994
		MX 9307166 A1	30-06-1994
		US 6500538 B1	31-12-2002
		US 5482772 A	09-01-1996
WO 2007071496 A	28-06-2007	EP 1966256 A1	10-09-2008
EP 1452630 A	01-09-2004	AT 417948 T	15-01-2009
		WO 2004076726 A1	10-09-2004
US 5900306 A	04-05-1999	AR 001823 A1	10-12-1997
		AU 702996 B2	11-03-1999
		AU 5713796 A	21-11-1996
		BR 9608218 A	06-04-1999
		CA 2217123 A1	07-11-1996
		CN 1188446 A	22-07-1998
		DE 69609711 D1	14-09-2000
		DE 69609711 T2	14-12-2000
		EP 0823878 A1	18-02-1998
		ES 2151661 T3	01-01-2001
		WO 9634741 A1	07-11-1996
		ZA 9603422 A	08-08-1996

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Non-patent literature cited in the description

- **G.J. Ray et al.** *Macromolecules,* 1977, vol. 10 (4), 773-778 **[0034]**
- Plastics Additives Handbook. Hanser Publishers **[0042]**
- **F. Fourné.** Synthetische Fasern. Carl Hanser Verlag, 1995 **[0044]**
- **B.C. Goswami et al.** Textile Yarns. John Wiley & Sons, 1977, 371-376 **[0044]**