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The invention relates to a non-woven fibre fabric, also, in particular, in the form of a flat material or as part of a flat material, a method for its production as well as various uses of the non-woven fibre fabric.

WO 2007/122232 A2 discloses a method for the production of gelatine fibres. With this method, an aqueous gelatine solution exits from a spinning opening while at the same time compressed air is blown out of air nozzles in order to make the fibres, which are formed, thinner or stretch them. A non-woven fibre fabric can be formed from the fibres produced in this manner.

JP 03-086822 B1 describes the production of gelatine fibres by means of a coacervation method, with which an aqueous gelatine solution is extruded into an organic solvent. These fibres can subsequently be pressed to form a non-woven fibre fabric.

GB 862428 discloses a method and a device for the production of fibres from different natural or synthetic macromolecular substances, inter alia gelatine, which are converted into a thermoplastic state as a result of heating and then spun.

The invention is aimed, in particular, at non-woven fibre fabrics which can be used as a biodegradable material in medicine, in particular as implants or carrier materials for living cells (tissue engineering), but also at non-woven

fibre fabrics which may be used in food technology in a variety of applications, in particular as preliminary products for foods.

For this purpose, a new non-woven fibre fabric is suggested in accordance with the invention which contains fibres which consist of a gelatine material and have a thickness of, on average, 1 to 500 µm, wherein the non-woven fibre fabric has a plurality of areas, at which two or more fibres merge into one another without any phase boundary, wherein the non-woven fibre fabric contains two or more fibre fractions with different average fibre thicknesses, and wherein the non-woven fibre fabric has an open pore structure with an air permeability of 0.5 l/min• cm^2 or more, measured according to the DIN 9237 standard. The special feature of the non-woven fibre fabrics according to the invention is to be seen, in particular, in the fact that the linking of the fibres in the non-woven fibre fabric can be attributed to the areas, at which two or more fibres form a point of connection, at which no phase boundaries are apparent and, therefore, material conditions which are universally the same can be observed at the points of connection.

These areas are not, therefore, formed by any adhesion or welding of fibre surfaces which are adjacent to one another but rather the special feature is to be seen in the fact that the fibre surfaces disappear when the point of connection is formed.

Particularly for the purposes of the application in medicine and, in this case, in particular, for the purposes of tissue engineering, average fibre thicknesses in the range of 3 to 200 µm, in particular in the range of 5 to 100 µm, are recommended. The preferred fibre thicknesses allow, in particular, a simple colonization of the non-woven fibre fabric with living cells for the formation of implants.

The non-woven fibre fabrics according to the invention may be easily produced with the open pore structure desired for the cell colonization and offer a very large, specific surface for this purpose.

At the same time, the non-woven fibre fabrics according to the invention form, when observed macroscopically, a carrier material which is beneficial for a homogenous cell distribution following the colonization. The interconnecting pore structure of the non-woven fibre fabrics according to the invention, which is superior to that of porous sponge structures, is particularly advantageous for the subsequent growth of cells.

The non-woven fibre fabrics according to the invention may also be achieved with a sufficient form stability which is also adequately maintained in the wetted state. This may be ensured, in particular, by an adequate number of individual fibres which have a large diameter.

The resorption of the carrier structure of the non-woven fibre fabric in the case of implants is also ensured on account of the biological tolerance of the gelatine material.

The gelatine material in the fibres is biodegradable in a particularly simple manner and for controlling the degradation behaviour of the fibres of the non-woven fibre fabric it is advantageously provided for the gelatine material of the fibres to be cross-linked at least partially. The degradation behaviour may be controlled via the degree of cross-linking and also the strength of the non-woven fibre fabric influenced in a moist to completely wetted or swollen state.

In a particularly preferred embodiment of the present invention, the gelatine material of the fibres is predominantly amorphous. This has the advantage

that a gelatine material of the fibres in the amorphous state can easily be wetted. This is particularly the case when the gelatine material of the fibres is present in an amorphous state to 60 % by weight or more.

This may also be expressed as initial wettability with pure water which is intended to be 1 minute or less. This specification of time is measured in accordance with the time which is required for the absorption of a drop measuring 50 µl by a non-woven fibre fabric with the weight per unit area of 150 g/m². The good initial wettability is expressed, for example, by the fact that a sample of the non-woven fibre fabric placed on a surface of water will be wetted, as it were, instantaneously and by absorbing water will sink into the water.

The capillary suction effect may be used to characterize the structure of the non-woven fibre fabric, in particular its cavity structure. In the case of preferred non-woven fibre fabrics with pure water, this should generate a height of rise of the water of 15 mm or more within 120 seconds.

In a further, preferred embodiment of the invention, the maximum water absorption capacity of the non-woven fibre fabric, which is brought about by or is co-dependent on, in particular, a swelling of the gelatine material used for the fibres, is at least four times the dry weight of the non-woven fibre fabric, i.e., preferably 4 g or more, in particular 10 g or more per gram of non-woven fibre fabric.

Non-woven fibre fabrics according to the invention preferably have a surface energy of 25 mN/m or less, in particular 10 mN/m or less. This facilitates the initial wetting of the non-woven fibre fabric.

The tear resistance, which is preferably 0.15 N/mm² or more at a specific weight per unit area of the non-woven fibre fabric in the range of 140 to 180 g/m² in the dry state, is of particular importance for the non-woven fibre fabrics according to the invention, wherein a breaking elongation in the hydrated state (state of maximum water absorption due to swelling) of the non-woven fibre fabric is, in addition, preferably 150 %, in particular 200 % or more.

Such non-woven fibre fabrics are excellent to handle, in particular, in the case of medical applications in the dry state and also offer an adequate strength in the hydrated, i.e., swollen state and so they may be adapted very easily to the conditions of the body at the implant site when used as implant carrier materials. In particular, a satisfactory suturing strength is also achieved for fixing the implants.

The non-woven fibre fabrics of the present invention have an open pore structure with a permeability of the non-woven fibre fabric to air of 0.5 l/min x cm² or more, wherein this parameter is determined in accordance with German Standard 9237. Non-woven fibre fabrics are particularly preferred, with which the gelatine material of the fibres is present in a partially cross-linked gel form, which means that the stability of the non-woven fibre fabric at the body temperature of a patient is sufficient, on account of the cross-linking, even in the swollen state, for it to be handled without the non-woven fibre fabric thereby tearing or being damaged in another way.

In this respect, those non-woven fibre fabrics are of importance, in particular, which form a closed-pore fibrous gel structure in a hydrated state. This means that the non-woven fibre fabrics, which can and should certainly have an open pore structure in the dry state, lose their open porosity on account of

the considerable amounts of water absorbed by the gelatine parts and the swelling following therefrom and then form a closed-pore, fibrous gel structure. This is of particular significance when the tissue areas to be covered by an implant bleed profusely and the implant is also intended to be used at the same time as a cover for open wounds or for the purpose of stopping bleeding.

The non-woven fibre fabric of the present invention has, in particular, fibres consisting of gelatine material which are produced with a rotor spinning process and at least some of the fibres have an intertwined structure.

Preferred gelatine materials as starting materials for the production of fibres for the non-woven fibre fabric according to the invention have a gel strength of 200 Bloom or more.

Additional, preferred embodiments of the present invention relate to non-woven fibre fabrics of the type described above, with which the non-woven fibre fabric contains at least one additional type of fibres which are formed from an additional material different to the gelatine material.

Such additional materials, from which the additional type of fibres can be formed, are, in particular, chitosan, carrageenan, alginate, pectin, starch and starch derivatives, regenerated cellulose, oxidized cellulose and cellulose derivatives, such as, for example, CMC, HPMC, HEC and MC. In addition, synthetic biocompatible polymers are suitable, such as, for example, polylactic acid and polylactate copolymers, polydihydroxysuccinic acid, polycaprolactons, polyhydroxybutanoic acid and polyethylene terephthalate. In addition, gelatine derivatives are suitable, such as, for example, gelatine terephthalate, gelatine carbamylate, gelatine succinate, gelatine dodecyl succinate, gelatine

acrylate (cf., for example, EP 0 633 902), as well as gelatine copolymers, such as, for example, gelatine polylactide conjugate (cf. DE 102 06 517).

The invention relates, in addition, to a flat material, containing a non-woven fibre fabric according to the invention which has already been explained in detail in the above. Such flat materials can contain one or several layers of the non-woven fibre fabric according to the invention.

The flat materials according to the invention contain a membrane extending parallel to the non-woven fibre fabric for certain application purposes.

The membrane can, in this respect, serve as a carrier layer for the non-woven fibre fabric and so very low weights per unit area can, in particular, be realized in the case of the non-woven fibre fabric.

Alternatively or in addition, the membrane can form a barrier layer which inhibits the proliferation of cells and so an undisturbed growth of the cells which are desired or have been introduced into the implant is possible, in particular, with the use as a carrier material for tissue engineering applications. In this connection, it is also advantageous when the membrane is permeable for cell nutrients.

The invention relates, in addition, to a flat material of the type described above, wherein the non-woven fibre fabric is colonized by living cells, in particular chondrocytes or fibroblasts.

With these applications, fibre diameters of, in particular, on average 3 µm or more are used and so the cell colonization is simple to configure. In this

respect, pore sizes of, on average, approximately 100 µm to approximately 200 µm are preferred.

The invention relates, in addition, to the use of the non-woven fibre fabric described above as well as the flat material likewise described above as a cell colonization material.

The invention relates, in addition, to the use of the non-woven fibre fabric described above as well as the flat material described above as a medical wound cover.

The invention relates, in addition, to the use of the non-woven fibre fabric described above as well as the flat material described above as a medical implant.

The invention relates, in addition, to the use of the non-woven fibre fabric described above as a food.

The non-woven fibre fabrics according to the invention and the flat materials according to the invention can also be used for the production of depot medicines. In this respect, it may also be provided for the gelatine material of the fibres to contain a pharmaceutical substance.

Optionally, in addition or alternatively, the non-woven fibre fabric according to the invention and the flat material according to the invention can serve as a carrier for a pharmaceutical substance.

A preferred pharmaceutical substance, in particular for use as a material for covering wounds, is the substance thrombin.

In addition or alternatively, the pharmaceutical substance can contain cell growth factors, in particular a peptide pharmaceutical, in particular growth modulators, such as, for example, BMP-2, BMP-6, BMP-7, TGF-ß, IGF, PDGF, FGF.

The invention relates, in addition, to a method for producing non-woven fibre fabrics of the type described above, wherein the method includes the steps of:

(a) providing an aqueous spinning solution which contains a gelatine material;

(b) heating the spinning solution to a spinning temperature;

(c) processing the heated spinning solution in a spinning device with a spinning rotor;

(d) collecting the fibres generated by forming a non-woven fibre fabric with a plurality of areas, at which two or more fibres merge into one another without any phase boundary;

(e) and, optionally, an additional treatment of the non-woven fibre fabric obtained by adding property-changing additions in a fluid or gaseous state of aggregation,

wherein a spinning rotor is used which has spinning openings of different sizes so that fibres with different average thicknesses result.

The method according to the invention operates as a rotation spinning method, with which the fibres or filaments generated by the spinning rotor are collected as non-woven fibre fabrics on a suitable collection device.

A suitable collection device is, for example, a cylinder wall which is arranged concentrically to the spinning rotor and which can, possibly, likewise be driven for rotation. A further possibility is the horizontal collection of the filaments on a base surface, for example a perforated metal sheet, which is arranged beneath the spinning rotor.

The flight time of the fibres or filaments can be predetermined via the distance between the exit openings of the spinning rotor and the collection device and this time is selected such that an adequate solidification of the spinning solution discharged in fibre form is made possible and so the fibre form is retained when impacting on the collection device.

This is aided, on the one hand, by the cooling of the fibre or filament materials during the flight time, on the other hand, by the gel formation of the gelatine and, in addition, by an evaporation of water or of the solvent.

The fibres or filaments generated by the spinning rotor may easily be collected in a state, in which points of connection between two or more fibres are formed in a plurality of areas of the non-woven fibre fabric and the fibres merge into one another at these points without any phase boundary.

In the optional additional treatment step (d), the non-woven fibre fabric according to the invention may be adapted to specific applications in a plurality of characteristics.

By cross-linking the gelatine material, the mechanical and, in particular, chemical properties can be modified. For example, the resorption properties for medical application purposes can be specified via the degree of cross-linking of the gelatine material.

The non-woven fibre fabric of the present invention, which is regularly highly flexible, may be stiffened in subsequent treatment steps, for example, in order to improve the form stability and to make the introduction into a target area easier.

The non-woven fibre fabrics according to the invention may be saturated and/or coated with liquid media in subsequent treatment steps. Other biodegradable polymer materials or also wax-like materials can, in particular, be considered for this purpose.

The non-woven fibre fabrics of the present invention, with which a fibre thickness of on average from 1 to 500 µm is generated, may be generated by means of the method according to the invention and described above, in particular, in a simple manner and wherein, in addition, the areas characteristic for the invention are formed, at which two or more fibres are connected or, as it were, melt into one another without any phase boundary. A spinning solution, with which the proportion of gelatine is in the range of approximately 10 to approximately 40 % by weight, is preferably used for the method according to the invention.

The gel strength of the gelatine is, in this respect, preferably approximately 120 to approximately 300 Bloom.

The spinning solution is preferably heated to a spinning temperature in the range of approximately 40°C or more, in particular in the range of approximately 60 to approximately 97°C. These temperatures enable, in particular, a simple formation of the characteristic areas of the non-woven fibre fabrics, at which two or more fibres are connected to or merge into one another without any phase boundaries.

The spinning solution is preferably degassed prior to the processing in step (c) and so long fibres with a very homogeneous fibre thickness are obtained in the non-woven fibre fabric.

The degassing will preferably be carried out by means of ultrasound.

Preferably, a cross-linking agent will already be added to the spinning solution to generate partially cross-linked gelatine materials in the fibres. Cross-linking may, however, also be brought about and in addition in the case of the fibres already spun by bringing them into contact with a cross-linking agent, whether gaseous or in solution.

The method according to the invention can be carried out particularly reliably when the rotor is heated to a temperature of approximately 100 to approximately 140°C. This temperature is particularly suitable for processing the aqueous spinning solutions, which contain gelatine materials, in the rotation spinning method.

A further cross-linking will preferably be carried out on the non-woven fibre fabric which is already finished and this determines the final degree of cross-linking of the gelatine material in the non-woven fibre fabric and, therefore, its biodegradability.

Various methods are available for the cross-linking, wherein enzymatic methods, the use of complexing agents or chemical methods are preferred.

In the case of the chemical cross-linking, the cross-linking will be carried out by means of one or more reactants, in particular, with aldehydes, selected from formaldehyde and dialdehydes, isocyanates, diisocyanates, carbodiimides, alkyl dihalides and hydrophilic dioxiranes and trioxiranes, such as, for example, 1.4 butanediol diglycidether and glycerine triglycidether.

It is recommended, in particular, in the case of the medical application to remove surplus cross-linking agent from the non-woven fibre fabric or the flat material following the cross-linking.

As described above, it is preferable for a cross-linking agent to already be added to the spinning solution and for a further cross-linking to then be carried out on the finished non-woven fibre fabric, so-to-speak in a second step, until the desired degree of cross-linking is reached.

The non-woven fibre fabrics of the present invention can be produced, in particular, as extremely flexible flat materials, are thereby elastic and are very easy to shape. In addition, the non-woven fibre fabrics can be regarded as structures which are completely open in comparison with sponge structures which have likewise already been used as a carrier material for tissue engineering and are likewise porous but have cell walls.

In this respect, very small filament thicknesses may be produced, in particular, with the spinning rotor spinning method suggested in accordance with the invention, wherein the gelatine need be subjected to higher

temperatures only for a very short time during the entire spinning process, i.e. the temperature burden on the gelatine material can be limited to a considerable extent with respect to time and leads to fibres consisting of a gelatine material which corresponds essentially to the initial gelatine material in its molecular weight spectrum.

Non-woven fibre fabrics can, within the scope of the present invention, have a proportion of fibres, the average fibre thickness of which differentiates them from the other fibres. They can, in particular, have a larger average fibre thickness. By using two or more fibre fractions in the non-woven fibre fabric which differ as a result of their average fibre thickness, its mechanical strength values can be influenced in a targeted manner.

Alternatively or in addition, two or more layers of non-woven fibre fabric can, on the other hand, be combined to form a flat material, wherein the individual layers can have fibres of different, average fibre thicknesses. It is, of course, also possible in the case of these flat materials to use layers of non-woven fibre fabric with fibres of an essentially uniform, average fibre thickness together with layers of non-woven fibre fabric with several fibre fractions having different, average fibre thicknesses.

Non-woven fibre fabrics with fibre fractions having different, average fibre thicknesses, e.g. approximately 7 µm together with approximately 25 µm, may be realized with the method according to the invention in that a spinning rotor is used, in which spinning nozzles with nozzle openings of different sizes are provided during the spinning procedure.

When the non-woven fibre fabric according to the invention is used as a carrier material for living cells, the non-woven fibre fabric has a great advantage over sponge structures or woven fabric structures in that very varied cavities are offered for the storage of the cells and so the cells can find the storage locations which are ideal for them. This already applies for non-woven fibre fabrics which have a uniform, average fibre thickness.

These and further advantages of the present invention will be explained in greater detail in the following on the basis of the drawings as well as examples.

The drawings show in detail:

Figure 1: a schematic illustration of a device for carrying out the method according to the invention;

Figures 2a to c: micrographs of a non-woven fibre fabric according to the invention in different enlargements;

Figure 3: a graph of height of rise/time for different materials;

Figures 4a to c: a schematic illustration of a device for calculating the heights of rise illustrated in Figure 3; and

Figures 5a and b: tension/elongation results for conventional cell carrier materials and those according to the invention.

Reference Example 1:

Production of a Non-woven Fibre Fabric

A 20 % aqueous solution of a pork rind gelatine (300 Bloom) is produced by mixing 20 g of gelatine and 80 ml of distilled water at room temperature. After the gelatine has swollen for a period of approximately 60 minutes, the solution is heated for one hour to 60°C and subsequently degassed with ultrasound.

This solution is then processed with a spinning device 10, as shown schematically in Figure 1. Spinning devices of the type described in DE 10 2005 048 939 A1 are also suitable and reference is made to the content of this publication in full.

The spinning device 10 includes a spinning rotor 12 which can be caused to rotate about a vertical axis of rotation 16 by a drive unit 14.

The spinning rotor 12 has a container 18 for accommodating the aqueous gelatine spinning solution which can be supplied continuously during the spinning procedure from a supply channel 22 via a funnel 20.

The container 18 has at its outer circumference a plurality of openings 24, via which the spinning solution is discharged in a filament form due to centrifugal force.

A collection device 26 in the form of a cylinder wall is provided at a predetermined distance a from the openings 24 and collects the spinning solution shaped to form filaments or fibres. On account of the flight time

predetermined via the distance a at a specific rotational speed of the spinning rotor 12, the spinning solution forming the filaments or fibres will be solidified to such an extent that the filament form is essentially retained when impinging on the collection device 26; on the other hand, the areas, in which two or more fibres or filaments melt, as it were, into one another and create points of connection, at which the phase boundaries of the fibre sections abutting on one another are removed (cf., in particular, Figure 2b), can still be formed.

The spinning rotor 12 together with the drive unit 14 and the collection device 26 are arranged in a housing 28 which separates a spinning chamber from the surroundings.

In the present example, the spinning rotor 12 is driven at a rotational speed of 2,000 to 3,000 U/min. The rotor 12 is heated to a temperature of 130°C. The gelatine solution is heated to 95°C and supplied to the rotor 12 so that a continuous generation of filaments can be carried out. The filaments are collected on the collection device 26 as fleece by means of suction. The distance a is approximately 20 cm and, therefore, defines a flight time of approximately 0.01 m/sec.

The average diameter of the filaments or fibres obtained may be influenced via the size of the openings 24 of the container 18 of the spinning rotor 12, the rotational speed of the spinning rotor 12 as well as the concentration of gelatine in the spinning solution. In the present example, the diameter of the openings 24 is approximately 0.9 mm.

In the example specified above, filaments with a filament thickness in the range of 2.5 to 14 µm (average fibre thickness 7.5 µm ± 2.6 µm) are obtained. An example of a non-woven fibre fabric which can be obtained with

the method according to the invention is illustrated in Figures 2a to c in different enlargements.

The relatively loose non-woven fibre fabric as shown in Figure 2a can, of course, also be obtained with a higher filament or fibre density but non-woven fibre fabrics with the density as shown in Figure 2a can also be connected, when several are placed one on top of the other, to form a self-supporting sheet material in the form of a fleece or, however, be placed on carrier materials, such as, for example, membranes or films.

Figure 2b shows, in a scanning electron micrograph, the non-woven fibre fabric 30 according to the invention which can be obtained with the method according to the invention with a plurality of fibres 32 consisting of a gelatine material and, in particular, the areas 34 which distinguish the invention and in which two or more fibres 32 are connected to one another without a phase boundary.

In Figure 2c, the effect of the intertwining of the individual filaments 36 is made visible in a light micrograph in polarized light, wherein the intertwining sections are visualized by way of light-dark areas 38.

Reference Example 2:

Production of a Cell Carrier Material

Predetermined pieces of material are punched from the non-woven fibre fabric obtained in Example 1 and placed in layers on top of one another until a fleece with a desired weight per unit area, for example in the range of approximately 20 to approximately 500 g/m², is achieved.

In the present Example, a multi-layered fleece, formed with a weight per unit area of 150 g/m2, is produced and, subsequently, partially cross-linked with the aid of gaseous formaldehyde. The cross-linking conditions in detail were as follows:

The non-woven fibre fabric is incubated in a gas atmosphere for approximately 17 hours over a formaldehyde solution of 10 % by weight. Subsequently, the non-woven fibre fabric is slow cooled in a refrigerator for 48 hours at approximately 50°C and 70 % relative humidity. The cross-linking reaction is hereby completed and the surplus amount of formaldehyde (cross-linking agent) which was not used will be removed.

Samples were punched from fleeces produced in this manner and compared in their water absorption properties as well as mechanical properties with conventional cell carrier materials in the form of porous gelatine sponges as well as a material consisting of oxidized cellulose.

The width of the sample was 1 cm each time.

Figure 3 shows the height of rise of pure water plotted against the time for these three materials, wherein the curve designated with the letter A corresponds to the fleece according to the invention as a multi-layered non-woven fibre fabric, the curve B a conventional gelatine sponge and the curve C the conventional cellulose material which is commercially obtainable.

It is obvious from the comparison of the absorption of water over the unit of time that gelatine materials are clearly superior to the cellulose materials such as those used in sample C.

The sample of fleece from the non-woven fibre fabric according to the invention and according to curve A is, again, clearly superior to the gelatine material in a sponge form (curve B) in its water absorption capacity per unit of time, as is apparent from Figure 3.

The practical advantage of this speed of water absorption, which is increased considerably, is to be seen in the fact that liquids, such as, for example, blood, will be absorbed more quickly and to a greater extent and, in the case of wounds which are to be treated, this leads to an improved staunching of the bleeding.

In Figures 4a to c, the principle for measuring the height of rise per unit of time is illustrated schematically. The prepared sample 40 is clamped via a holding device 42 so as to hang freely downwards and placed over a basin 44 with temperature-controlled water (25°C). At the beginning of the measurement, the basin with the water is moved upwards to such an extent that the sample dips into the supply of water to a depth of 2 mm. Subsequently, the height of rise which is generated via capillary forces is registered as a function of time and then entered in the graph according to Figure 3. A measuring stick 46 applied to the sample 40 makes the reading of the height of rise easier.

Tension/elongation measurements were also carried out on the samples described above with a width of 15 mm and a thickness of approximately 1 mm, namely in the dry state (Figure 5a). Only the two samples based on gelatine were compared, i.e., on the one hand, the fleece produced in accordance with the invention and, on the other hand, the conventional sponge sample with the same dimensions.

It is apparent from Figure 5a that the gelatine fleece in accordance with the present invention has a considerably higher specific tensile strength in comparison with the gelatine sponge in the dry state (water content approximately 10 % by weight) and, in addition, allows a considerably greater elongation in the dry state, as well. Whereas the tension/elongation curve for the gelatine sponge sample (curve B) already breaks off after an elongation of approximately 7 to 8 %, i.e. the sample tears, the fleece sample according to the invention may be stretched by approximately 17 % before any tearing of the sample is observed. In this respect, a considerably higher tensile strength in comparison with the sponge sample is also ascertained.

In the completely hydrated state of the samples (Figure 5b), i.e. in a state, in which the cross-linked gelatine material of the sponge or of the fleece according to the invention are completely swollen, even greater and more significant differences are obtained. The water content is, in this case, more than 100 % by weight in relation to the gelatine material.

A standard sponge in the size 80 x 50 x 10 mm as well as the fleece according to the invention in the size 80 x 50 x 1 mm were used for the comparison. The sponge has a dry weight per unit area of 120 g/m², the fleece one of 180 g/m².

In this case, tearing of the sample is observed for the sponge sample after an elongation of just about 75 % (curve B) whereas the fleece sample according to the invention may be stretched to 400 % (curve A) before it finally tears. In the hydrated state, as well, the fleece (with 2.6 N tensile force) achieves a higher strength than the sponge.

This is of quite particular significance for the use of the fleece materials as carriers for cell implants since this gives the attending physician the possibility of deforming, stretching and adapting the cell implant to the conditions of the wound of the patient to be treated almost as required.

Reference Example 3:

Production of Sugar-free Candy Floss

Analogous to Example 1, a 20 % by weight aqueous spinning solution is produced with the following composition:

15 g of gelatine type A, 260 Bloom, edible quality
15 g of gelatine hydrolysate type A, average molecular weight 3 kD
70 g of water

Colouring matter (e.g., raspberry) and aromas (e.g., vanilla-cola) can be added according to the producer's specifications.

The spinning solution is heated to 70°C and spun in the spinning rotor.

The product collected has the consistency and sensory perception of candy floss.

Patentkrav

1. Fibermåtte, omfattende fibre af et gelatinemateriale, hvor tykkelsen af fibrene i gennemsnit er 1 til 500 µm, og hvor fibermåtten har en flerhed af områder, hvor to eller flere fibre går ind i hinanden uden fasegrænse, **kendetegnet ved,** at fibermåtten omfatter to eller flere fiberfraktioner med forskellig gennemsnitlig fibertykkelse, og at fibermåtten har en åben porestruktur med en luftgennemtrængelighed på 0,5 l/min·cm^2 eller mere, målt i henhold til DIN 9237.

2. Fibermåtte ifølge krav 1, **kendetegnet ved,** at fibrenes gelatinemateriale er amorft op til 60 vægt-% eller mere.

3. Fibermåtte ifølge et af de foregående krav, **kendetegnet ved,** at fibermåtten omfatter mindst en yderligere type fibre, som er dannet af et yderligere materiale, der er forskelligt fra gelatinematerialet.

4. Fibermåtte ifølge krav 3, **kendetegnet ved,** at det yderligere materiale er udvalgt blandt kitosan, karrageenin, alginat, pektin, stivelse og stivelsesderivater, regenereret cellulose, oxideret cellulose og cellulosederivater, såsom f.eks. CMC, HPMC, HEC og MC, gelatinederivater, især gelatineterephthalat, -carbamat, -succinat, -dodecylsuccinat, -acrylat, samt gelatine-copolymerer, såsom f.eks. gelatine-polylactidkonjugat.

5. Flademateriale med et eller flere lag, hvor mindst et af lagene omfatter en fibermåtte ifølge et af de foregående krav.

6. Flademateriale ifølge krav 5, **kendetegnet ved,** at et første lag omfatter en fibermåtte af fibre med en første gennemsnitlig tykkelse, og et andet lag omfatter en fibermåtte af fibre med en anden gennemsnitlig tykkelse, hvor den anden gennemsnitlige tykkelse er større end den første gennemsnitlige tykkelse.

7. Flademateriale ifølge krav 5 eller 6, **kendetegnet ved,** at det omfatter en membran, der strækker sig parallelt med fibermåtten.

8. Flademateriale ifølge et af kravene 5 til 7, **kendetegnet ved,** at fibermåtten omfatter levende celler, især chondrozytter eller fibroblaster.

9. Anvendelse af en fibermåtte ifølge et af kravene 1 til 4 eller et flademateriale ifølge et af kravene 5 til 7 som cellekoloniseringsmateriale.

10. Anvendelse af en fibermåtte ifølge et af kravene 1 til 4 som fødevareforprodukt.

11. Anvendelse af en fibermåtte ifølge et af kravene 1 til 4 eller et flademateriale ifølge et af kravene 5 til 7 ved fremstilling af et depotlægemiddel.

12. Anvendelse af en fibermåtte ifølge et af kravene 1 til 4 eller et flademateriale ifølge et af kravene 5 til 7 som bærer for et farmaceutisk aktivt stof.

13. Fremgangsmåde til fremstilling af fibermåtter ifølge et af kravene 1 til 4, omfattende de følgende trin

(a) tilvejebringelse af en vandig spindeopløsning, der omfatter et gelatinemateriale;

(b) opvarmning af spindeopløsningen til en spindetemperatur;

(c) forarbejdning af den opvarmede spindeopløsning i en spindeindretning med en spinderotor, hvor der produceres fibre ud fra gelatinematerialet; og

(d) opsamling af de producerede fibre under dannelse af en fibermåtte med en flerhed af områder, hvor to eller flere fibre går ind i hinanden uden fasegrænse,

kendetegnet ved, at der anvendes en spinderotor, som har spindeåbninger med forskellig størrelse, således at det resulterer i fibre med forskellig gennemsnitlig tykkelse.

14. Fremgangsmåde ifølge krav 13, **kendetegnet ved,** at spindeopløsningen omfatter en andel af gelatine i området af ca. 10 til ca. 40 vægt-%.

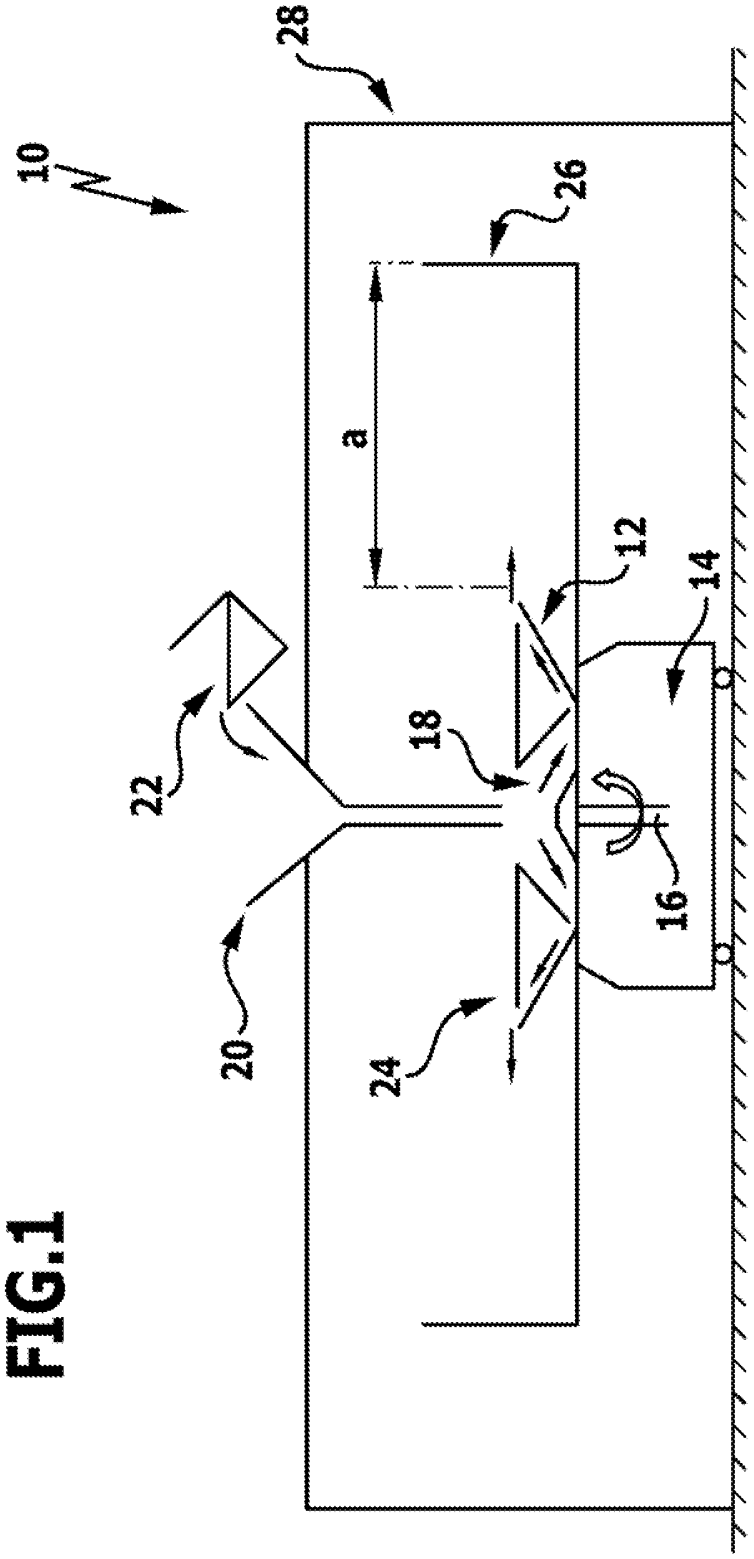


FIG.1

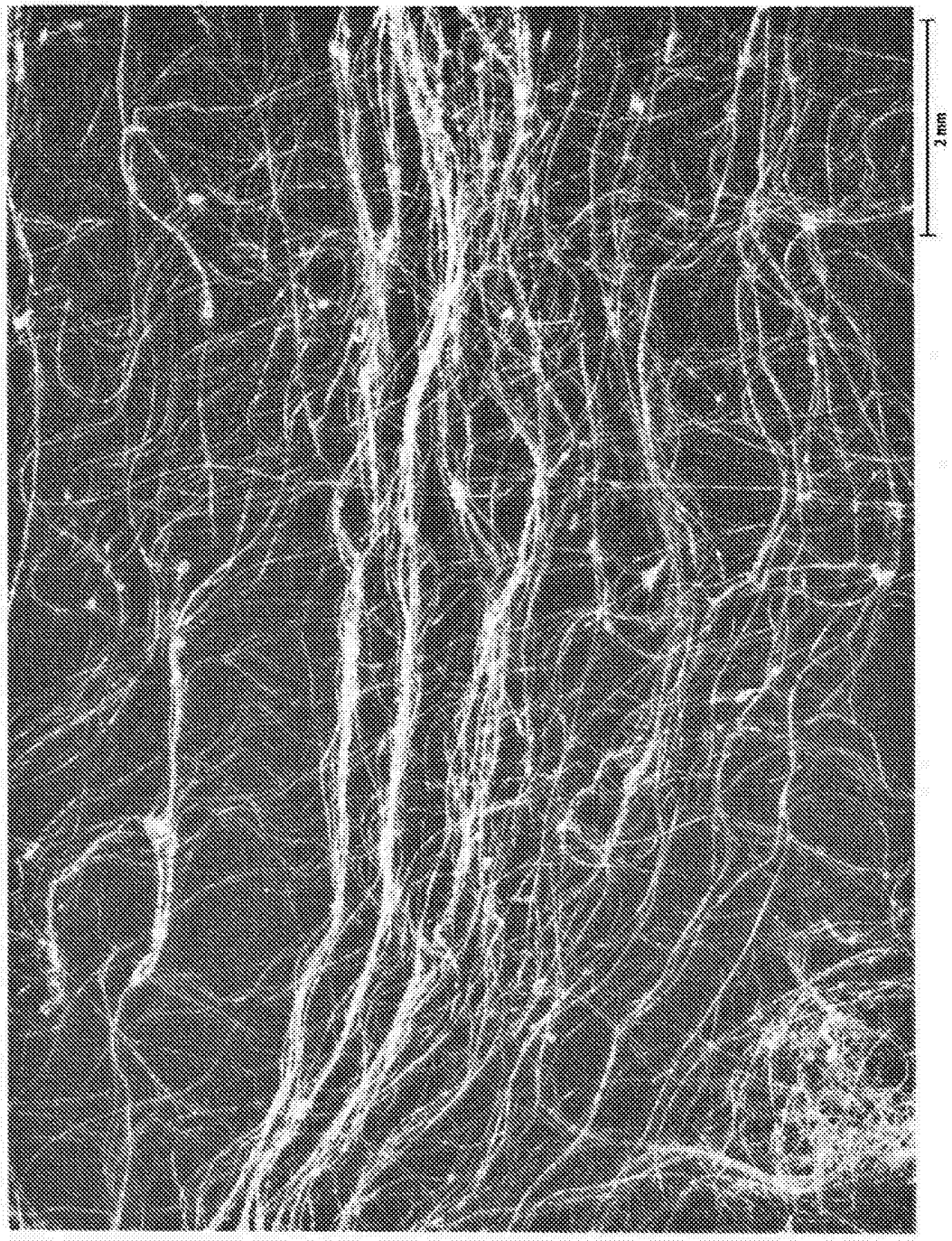


FIG.2a

FIG.2b

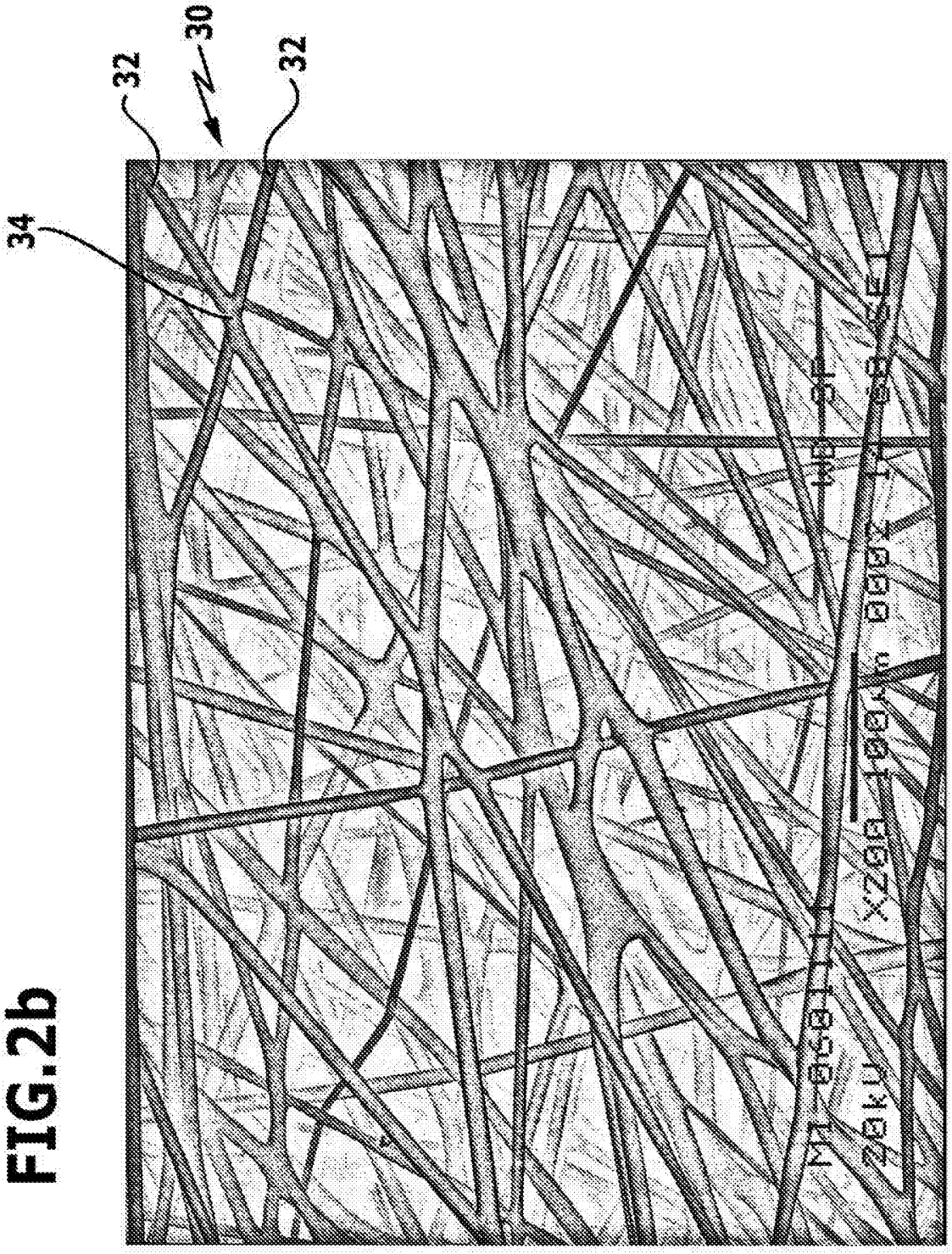


FIG.2c

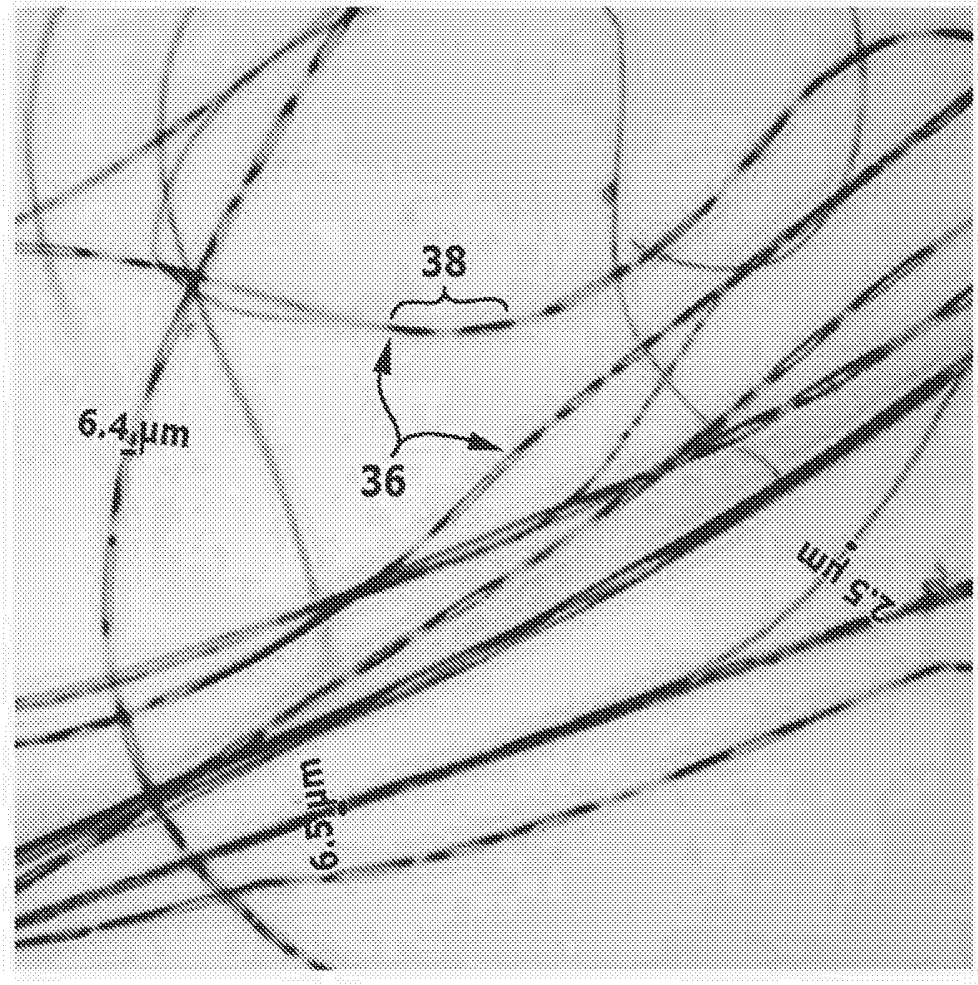


FIG.3

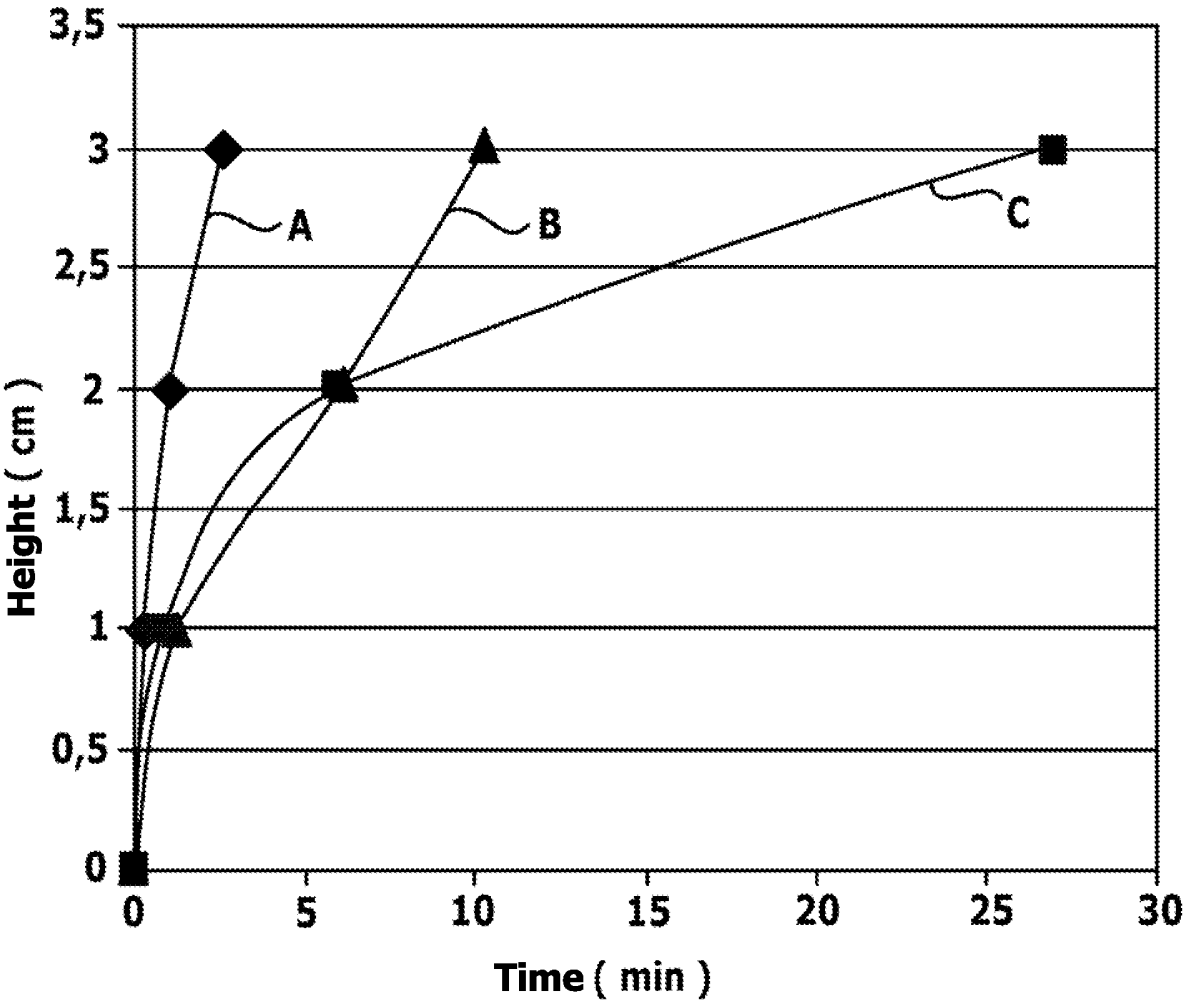


FIG.4a

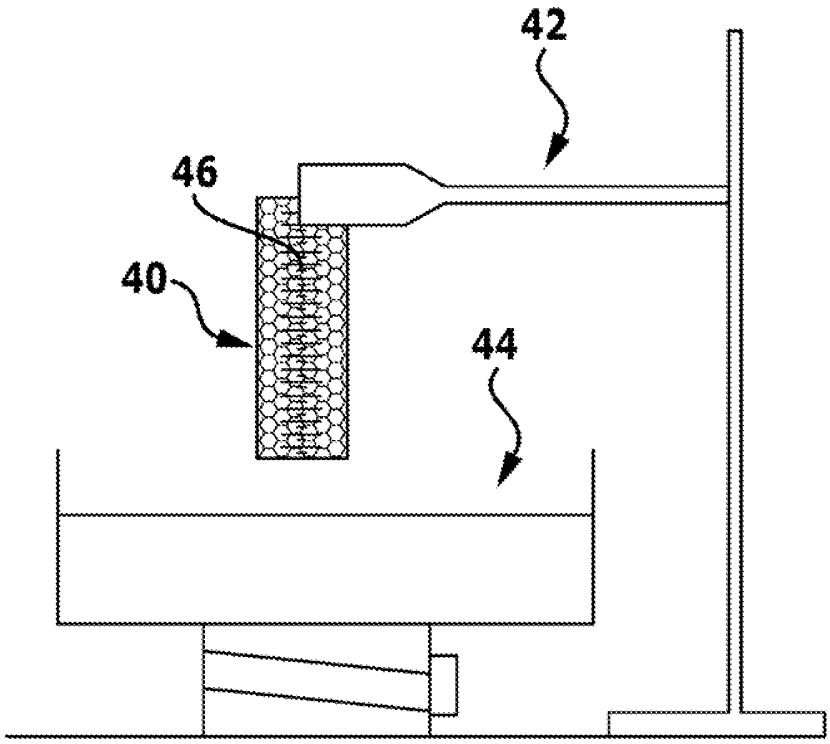


FIG.4b

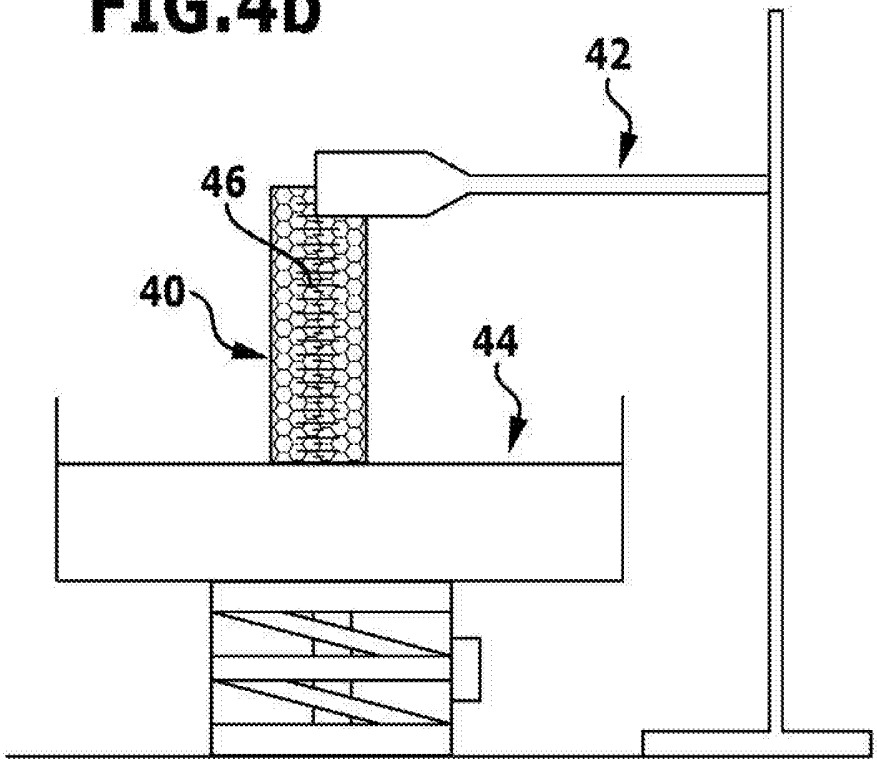


FIG.4c

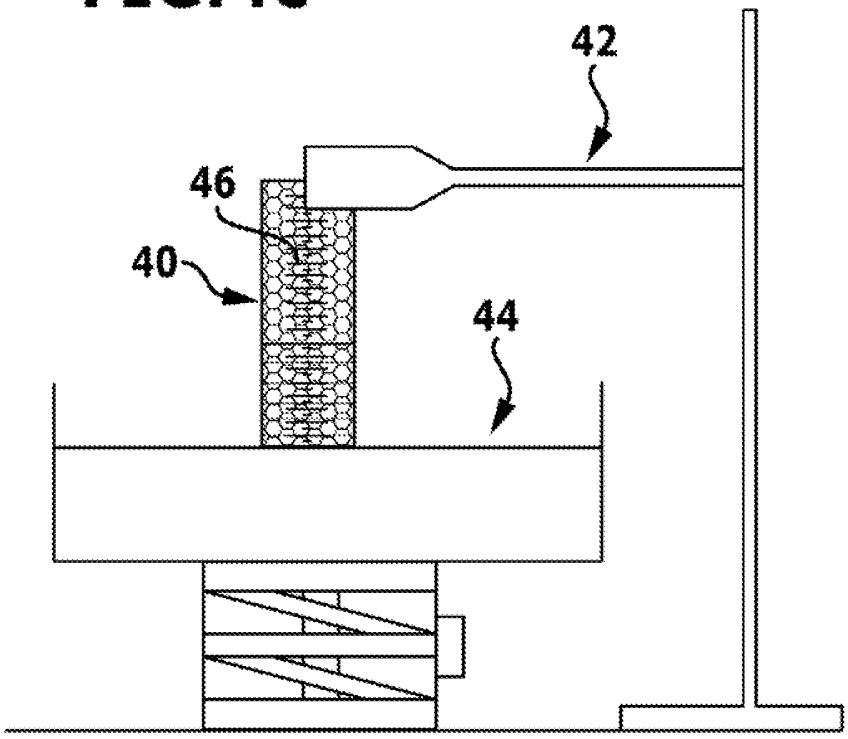


FIG.5a

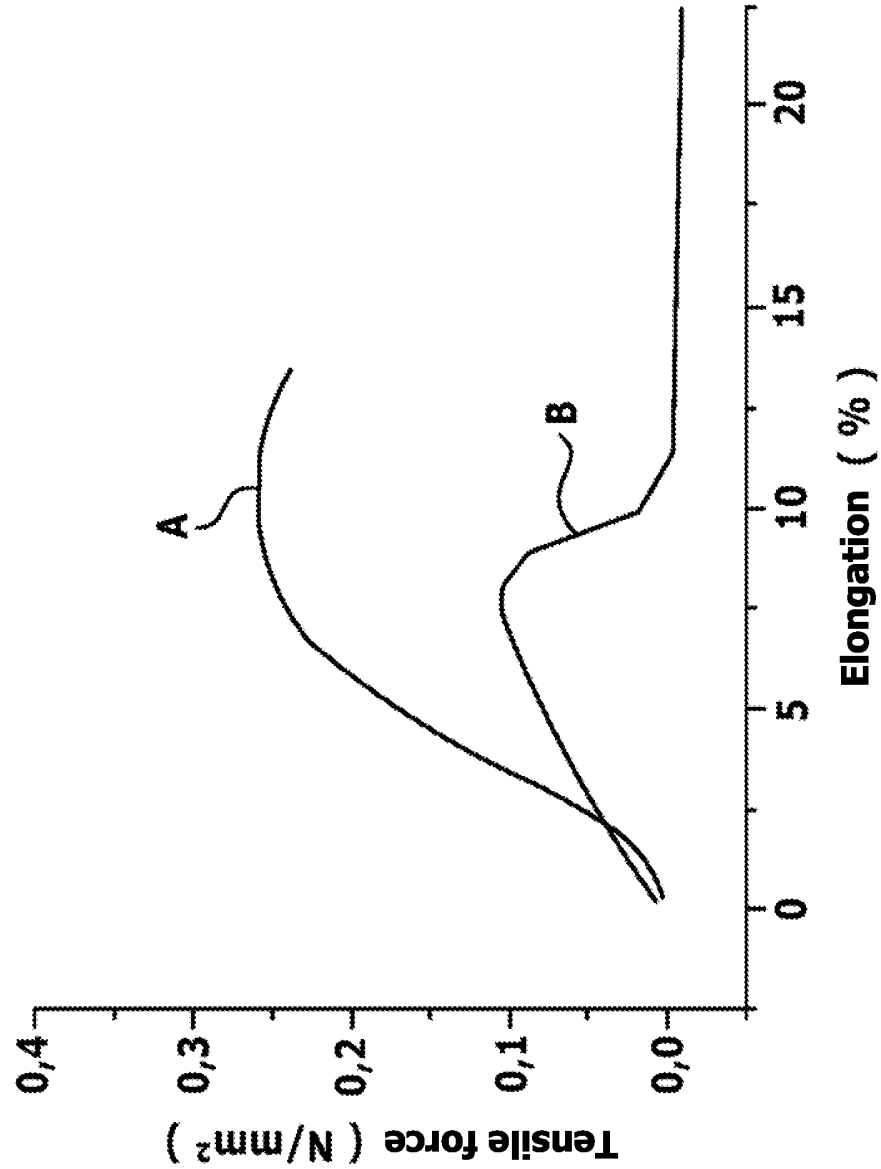
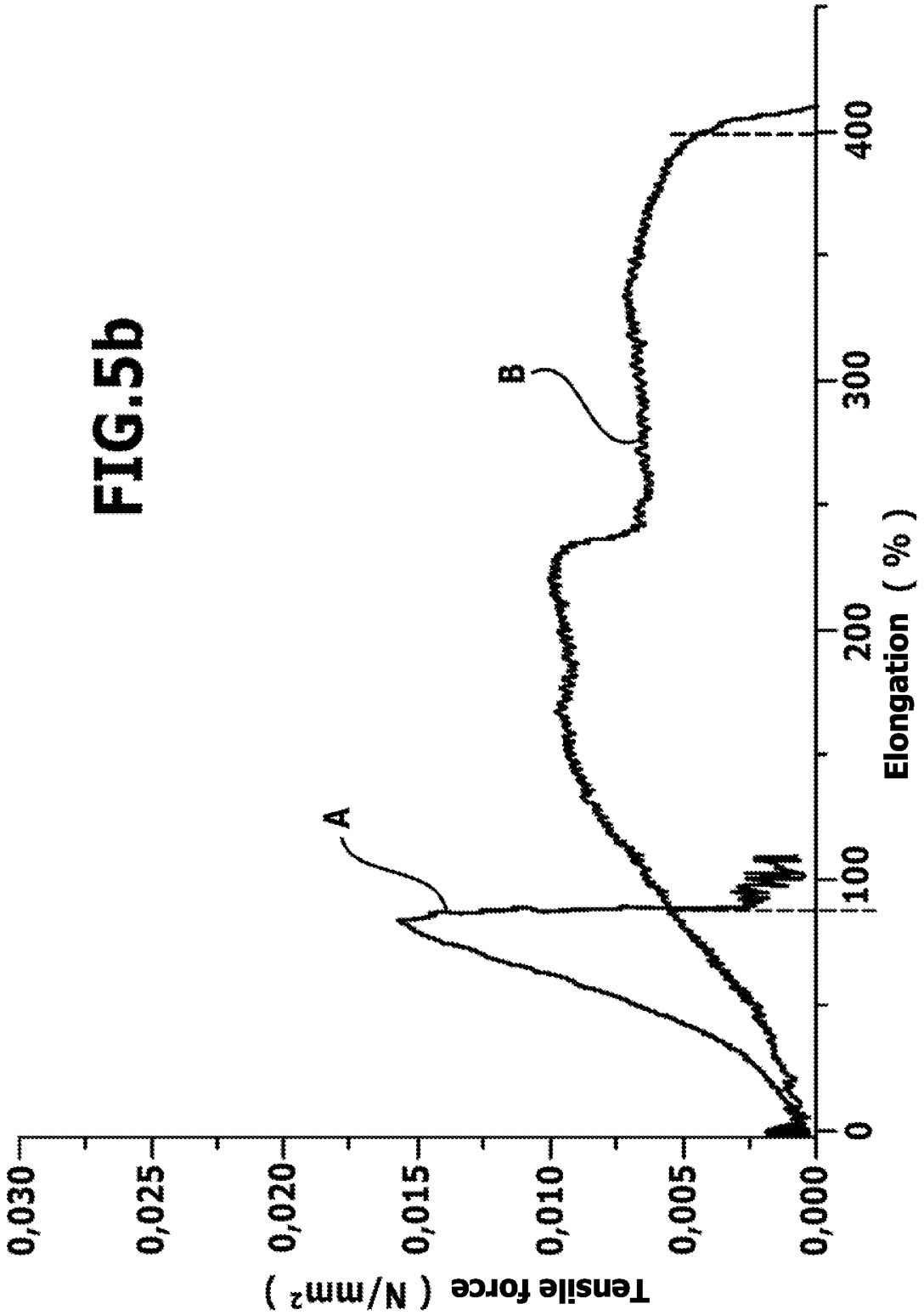


FIG.5b


Tensile force (N/mm²)
0,030
0,025
0,020
0,015
0,010
0,005
0,000
0
100
200
300
400
Elongation (%)
A
B