(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 123 181 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.11.2009 Bulletin 2009/48

(51) Int Cl.:
A41D 19/015 *(2006.01)*

(21) Application number: **09006716.6**

(22) Date of filing: **19.05.2009**

(84) Designated Contracting States:
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 SE SI SK TR

(30) Priority: **20.05.2008 DE 102008024299**

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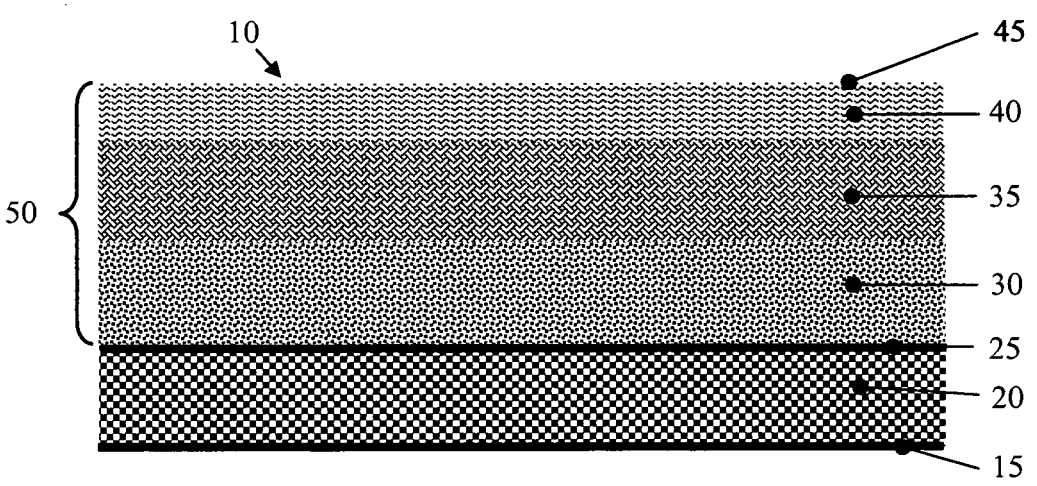
(54) Sports glove

(57) The invention relates to a sports glove, in particular a goal keeper glove with a layer system (50) comprising at least a layer (30, 35, 40) of foamed polyurethane-polyurea.

Figure 1



EP 2 123 181 A2

Description

1. Technical field:

[0001] The present invention relates to a sports glove, in particular to a goal keeper glove.

2. The prior art

[0002] Functional gloves in the sports field, in particular goal keeper gloves, have to fulfil several functions at the same time. For one thing, they may not limit the movement of the hand and the fingers; this means that they have to fit tightly to the hand and the fingers and have to be very flexible. Secondly, in particular, goal keeper gloves should have at their palm side damping properties, so that a sharply shot ball does not lead to an injuring to the fingers or the hand of the wearer. As a third important function, the gloves have to have at least on their palm side a surface having a very good grip. For example, a goal keeper glove should support catching of a ball under all weather conditions. For this purpose, it requires a corresponding coating on the inner surface of the glove and, where necessary, also on the back side of the hand. The aforementioned coating enables, for example, a controlled punching of a slippery ball. A good grip is difficult to realize, in particular, if the glove should have an adequate lifetime. A long lifetime can be realized with an abrasion resistant coating; however, this material property is often in conflict with the requirement of a good grip.

[0003] Currently, the outer coating of goal keeper gloves is made on the basis of polyurethane and latex foams.

[0004] Document DE 26 54 578 A1 discloses a goal keeper glove with a coating of polyurethane on the back side of the hand and with latex foam material on the palm side. Both coating materials are applied to a textile basic material.

[0005] The published patent application DE 100 39 887 A1 describes the application of latex foam material to increase the grip of goal keeper gloves, wherein the coating with a relief like structure is applied to a backing material with a stamping process. The gripping effect of latex foam material is activated by warm water and sustained by the blood heat of the wearer.

[0006] US patent US 4 555 813 explains the application of foam material on the basis of natural and synthetic latex to generate open pore coatings for work gloves.

[0007] As outlined in the above referenced documents, the coating of the palm side with latex foam material results in gloves with a good grip, in particular after activating the adhesiveness of the surface by a treatment with warm water.

[0008] However, the application of latex foam material for coatings of gloves leads to serious disadvantages. The good grip of surfaces with latex foam material is achieved at the expense of a very low lifetime of the coating. The abrasion resistance of such coatings is very low. Further, latex foam material is sensitive to UV (ultraviolet) radiation leading to porosity of the material. However, the most serious disadvantage of latex foam material coatings is damage to health, which may occur to the wearer of the corresponding gloves. Latex foam material may lead to skin irritations and elicit allergies. Therefore, alternative materials have been developed for some time as a replacement for latex foam material coatings.

[0009] The published patent application DE 195 282 A1 describes a coating on the inner surface with an adhesive synthetic material, consisting of polyurethane whose adhesiveness is adjusted by the mixing ratio of the starting compositions, polyol and polyisocyanate.

[0010] WO 99/02325 discusses the application of a polyurethane protecting layer from a foamed aqueous solution on a textile backing material of a glove using aqueous calcium nitrite as adherence primer.

[0011] However, the alternative solutions do not have the grip of latex foam material coatings up to now and are therefore not successful in the market.

[0012] The published patent application DE 10 2004 060 139 A1 describes a bimodel polyurethane-polyurea (PUR) dispersion having a high content of solids. By keeping the proportion of the small to the large polymer particles within a certain ratio, it is possible to make PUR dispersions with a high content of solids and having at the same time a low viscosity. DE 100 204 060 139 A1 mentions some applications without giving, however, any hint to the application of the new material in the field of sports.

[0013] The utility model document DE 20 2004 000 588 U1 describes a training handsponge which consists of an elastic material. The upper side of the training handsponge has a depression for the ball of the hand and has several depressions for fingers and the opposing rear side has an adhesive coating.

[0014] DE 101 22 444 A1 discloses ionic and/or non-ionic hydrophilized aqueous polyurethane polyurea dispersions (PUR dispersions) on the basis of polycarbonatepolyols and polytetramethylenecarbontate-polyols, a method of their fabrication as well as their application as coating agents, in particular for the manufacture of highly stable foam coatings in a single coat.

[0015] The present invention is therefore based on the problem to provide a sports glove with a high grip which overcomes at least partially the disadvantages of latex foam material coatings.

3. Summary of the invention

[0016] This problem is solved according to a first aspect of the invention by a sports glove of claim 1. In an embodiment a sports glove, in particular a goal keeper glove comprises a layer system comprising at least one layer of foamed polyurethane-polyurea.

[0017] A sports glove, formed according to an embodiment of the invention has a grip which is comparable with the grip of latex foam material coatings. In particular, in humid or wet conditions the grip of a coating according to the invention exceeds the grip of comparable latex foam material coatings significantly.

[0018] The wear comfort of gloves with PUR coatings is comparable with gloves having latex foam material based coatings. But, goal keeper gloves coated with foamed PUR have a significant longer lifetime than comparable goal keeper gloves with latex foam material coatings. The reason for this is a good abrasion and wear resistance of the new material resulting in a significantly improved resistance to wear compared with corresponding latex foam material coatings. Another important advantage of a coating according to the invention is its skin friendliness. The above mentioned problems which may occur with coatings based on latex foam material are avoided.

[0019] In a preferred embodiment the at least one layer of foamed PUR is arranged at an outside of the sport glove. The foamed PUR material absorbs impact forces and due to its stable foam matrix has a significant lifetime. Additionally, the foamed PUR material connects well to the backing layer on which it is applied.

[0020] By controlling the manufacturing process, the PUR material can be manufactured with substantially open pores at its outer surface so that it absorbs water. This feature is an important prerequisite for the application of the new material system in goal keeper gloves, since many goalkeepers are used dipping their gloves into water before using them. Again, by controlling during the manufacturing process, the PUR material can be manufactured with substantially closed pores at its outer surface for other applications so that the coating repels water.

[0021] In a further preferred embodiment the layer system comprises at least one tie-coat of foamed PUR arranged at the at least one layer. By distributing the two properties damping and grip to several layers, an optimal trade-off between these two functions can be adjusted while maintaining an acceptable lifetime. In an embodiment the at least one layer below the tie-coat has a larger pore size than the tie-coat, thereby the damping behaviour of the layer below the tie-coat is better than that of the tie-coat. On the other hand, the foamed PUR material of the tie-coat has a higher abrasion resistance than the layer below the tie-coat with its large pore size. Further, by varying the pore size of the PUR foam material, the ability to absorb water is adjusted. The pore size and therefore the density of the layer(s) of the layer system can be adjusted by the amount of added stabilising agents, cross linking agents, thickening agent, and foaming agents, as well as the amount of air added during the foaming process.

[0022] Furthermore, a particularly preferred embodiment comprises at least one further layer of foamed PUR. This layer can preferably be arranged between the layer below the tie-coat and the tie-coat layer. This middle layer of the layer system can have a pore size smaller than the layer below the tie-coat. It absorbs sufficiently water and has a large resistance to wear. With the number of layers, the pore size of the different layers and their thickness an optimum balance between the conflicting properties grip, abrasion and wear resistance can be obtained. It is possible to apply further layers, in particular for high quality sports gloves.

[0023] Further, a preferred embodiment comprises at the outer surface of the layer system a three dimensionally formed texture, in particular a leather grain texture. Beside a leather grain texture, the outer surface can have any other structure, for example, a ribbing, a diamond-like and/or a sandblasting structure. A structure at the outer surface offers a further possibility to adapt the grip of a glove.

[0024] There are two possibilities for the manufacture of a texture. If the PUR material is applied on a backing layer the texture can be embossed in the outer surface of the PUR material. In an alternative manufacturing process, the PUR material is applied head first on a backing paper having the negative pattern of the desired texture. The completed PUR layer is then attached with the side opposite to the backing paper to the backing layer of the sports glove, e.g. by gluing and after this the backing paper is removed from the textured surface.

[0025] In a further preferred embodiment the backing layer for the at least one layer comprises a plastic material, in particular polyurethane (PU), a three dimensional knit fabric, a woven fabric or natural or artificial material and/or leather. The foamed PUR material connects well with the materials which are used for sports gloves. For this reason, a part of the impact damping function can be assigned to the backing layer.

[0026] In a particularly preferred embodiment, the at least one layer is arranged at the palm side and/or on the back side of the hand of the glove. In particular the arrangement at the palm side of the hand is preferable, since with it a good grip can be obtained for catching a ball, wherein at the same time the PUR material of the one or several layer(s) can absorb impact forces of the ball. The arrangement of a corresponding PUR layer system at the back side of the hand of a goal keeper glove enables, for example, a controlled punching of a slippery ball.

[0027] Further, beneficial embodiments of the invention will be defined in further dependent patent claims.

4. Short description of figures

[0028] In the following, preferred embodiments of the present invention will be explained with reference to the attendant drawings:

Figure 1: A schematic representation of a layer composition of a sports glove according to an embodiment of the present invention;

Figures 2a, b: An enlarged cross section and a top view of a layer composition comprising a PUR layer system with three layers including a leather grain surface and associated backing layers according to a further embodiment of the present invention; and

Figures 3a, b: An enlarged cross section and a top view of a layer composition comprising a PUR layer system having one layer with a smooth surface and associated backing layers according to a further embodiment of the present invention.

5. Detailed description of preferred embodiments

[0029] In the following, presently preferred embodiments of an inventive sports glove will be explained in detail. This is preferably a goal keeper glove. However, the invention can also be applied to further kinds of sports gloves, for example, football gloves, golf gloves, snowboard gloves, cycling gloves, etc.

[0030] Furthermore, the layer systems explained in the following can be applied for further pieces of clothing in the field of sports. On the one side, the damping properties of the new material system can be exploited for shin guards, protective equipment for different kinds of sports, such as ice hockey, American Football, etc. On the other hand, a layer system of the new material applied for example to the outside of motor cycle clothing or ski clothing can attenuate falls by its damping properties and can effectively retard the slipping following the fall of the athlete.

[0031] Finally, it is also conceivable to apply the consecutively explained new material system to further sports goods such as balls for different kinds of ball games.

[0032] By mechanically foaming of the PUR material, a coating is manufactured whose foam structure has at least at its outer surface open pores and thus absorbs water. As already explained above, this feature is very important for goal keeper gloves. When the foaming is not done mechanically but by chemical foaming agents, the PUR layer has at least at its outer surface substantially closed pores, thus the coating repels water. This property is important for the coating of balls and/or sports clothes.

[0033] Figure 1 shows schematically a cross section of an exemplified layer composition 10 of a sports glove (not shown). The exemplified sports glove comprises in summary six layers. In other embodiments, the layer composition 10 may comprise more or less than six layers. A backing layer 15 of woven fabric fits tightly to the hand of the wearer. This layer comprises hard wearing material, which can be roughened at both surfaces completely or at selected positions. A rough surface of the backing layer 15 towards the hand avoids a relative movement of the glove and the hand. Furthermore, a roughened surface of the backing layer 15 towards the hand promotes the absorption of sweat by the material of the backing layer 15. In addition, a roughened and hence enlarged surface of the opposite side of the backing layer 15 facilitates connection with the material of the intermediate backing layer 20.

[0034] The material of the backing layer 20 can be made for example of foamed PU and sticks due to its adhesive property during the manufacturing process to the backing layer 15, or alternatively it can be glued to it. The material of the backing layer 20 should preferably withstand high stress, should not hamper the movement of the hand and the fingers and finally should be able to absorb impact energy. The backing layer 15 as well as the material for the backing layer 20 needs not cover the complete surface of the glove. Further, the material of the backing layer 20 can have different thicknesses across the surface of the glove and it may be missing at particular areas, for example, in the range of the finger joints.

[0035] A third backing layer 25 comprising again a hard wearing fabric can be arranged at the upper surface of the material of the second backing layer 20. The connection between the two layers 20 and 25 is carried out as described above in relation to the connection between the first backing layer 15 and the material of the second backing layer 20.

[0036] Three backing layers 15, 20, 25 are recommended for a good durability. However, only one of these backing layers 15, 20 and 25 is sufficient for a construction of the layer system 50 according to the invention. The PUR foam material, explained in the following, can be directly arranged to each of the backing layers 15 (embodiment not shown), 20 (embodiment not shown) and 25 (cf. Figures 2a and 3a). It is also possible to do without any backing layer 15, 20 or 25.

[0037] In Figure 1 the layer composition 10 comprises three layers 30, 35 and 40 of the inventive layer system 50 and three backing layers 15, 20 and 25. All three inventive layers 30, 35 and 40 comprise substantially the same polyurethane-polyurea system. The different layers 30, 35 and 40 may differ, however, according to the composition of the amount of contained stabilizing agents, cross linking agents, thickening agents and foaming agents and also with respect to the foaming process. The composition and manufacture of exemplified PUR layer systems 50 will be described below in detail.

[0038] The first layer 30 of the layer system 50 should connect well with the respective material of the backing layer 15, 20 and/or 25. For this purpose, it is preferable if the material of the backing layer 15, 20, 25 has a large pore size or open pores, respectively. This results in an effective enlargement of the surface facilitating an effective cross linking of the PUR layer 30 with the backing layers 15, 20 and/or 25.

[0039] The second layer 35 of foamed PUR of the layer system 50 of Figure 1 is arranged on the first layer 30 after drying. In a more beneficial alternative embodiment of the production process, the first layer 30 is not dried completely, but is transformed into a wet gel-like condition in an oven in a first drying step at a temperature of about 75° C. In this condition a second layer 35 is applied to the first layer 30. This alternative process (where layers 30 and 35 are dried together) has the advantage that the cross linking of both layers 30 and 35 at the layer boundary is better and more uniform than when separate drying processes are used for the first layer 30 and the second layer 35.

[0040] The two layers 30 and 35 can have the same thickness as is shown in Figure 2a, or they can have different thicknesses. The layer 35 will normally have a smaller pore size than the first layer 30. With this, the resistance to wear of the second layer 35 can be enhanced compared to the first layer 30. On the other hand, the larger pore size of the first layer 30 results in a better damping effect. By the selection of the corresponding pore sizes and the thicknesses of the layers 30 and 35 and, if necessary, of further layers which are not shown in Figure 1, an optimum balance between resistance to wear and damping can be adjusted for each purpose.

[0041] In the exemplified layer system 50 of Figure 1, a tie-coat 40 completes the layer composition 10 of the sports glove. The tie-coat 40, which is normally thinner than the layers 30 and 35 of the layer system 50, has preferably a pore size which is again smaller than that of the layer 35 to further enhance the abrasion resistance. As already described above, before the application of the tie-coat 40 the two layers 30 and 35 can be completely dried, or the first layer 30 can be completely dried and the second layer 35 can have a wet gel-like condition. It is also possible that both layers 30 and 35 have a wet gel-like condition after a twofold application of the first drying step described above after the application of each of the layers 30 or 35, respectively. In a preferred embodiment the drying steps of the layer system 50 are carried out in common to induce an optimum cross linking of the layers amongst each other during the drying and cross linking processes.

[0042] Further, it is possible to form a texture on the outer surface 45 of the tie-coat 40. In Figures 2b and 3b different textures on the outer surface 45 are presented. With the aid of this structure on the outer surface 45 of the tie-coat 40 of the layer system 50 the grip of the coating can be optimized.

[0043] Figure 2a shows a PUR layer system 50 composed of three layers 30, 35 and 40 as was discussed above in the context of Figure 1. Analogue to the embodiment shown in Figure 1, the layer system 50 of Figure 2a is applied to the backing layer system comprising three layers 15, 20 and 25. The material of the backing layer 20 comprises foamed PU and has on each of its upper and lower sides a thin backing layer 15 or 25, respectively of hard-wearing woven fabric. The thickness of the overall layer system 50 is approximately 3 mm, wherein the tie-coat 40 has a thickness of 0.4 mm. Each of the two layers 30 and 35 has substantially the same thickness of 1.3 mm. In the context of the present description, the terms "substantially" and "approximately" reflect manufacturing tolerances and/or measurement errors which may occur at different production steps.

[0044] Figure 2b represents the outer surface 45 of the layer system 50 of Figure 2a. The outer surface 45 comprises a leather grain structure.

[0045] Figure 3a shows a PUR layer system 50 with a single PUR layer 30 which is applied to the backing layer system comprising three layers 15, 20 and 25 which has been explained in the context of Figure 2a. The thickness of the PUR layer is approximately 2 mm. As it is shown in Figure 3b, the outer surface 45 of the single PUR layer 30 is flat in contrast to the textured tie-coat 40 of Figure 2b. As already mentioned, the grip of the sports glove can be adjusted by the kind of texture on the outer surface 45.

[0046] In an embodiment the at least one layer 30, 35, 40 of the PUR layer system 50 is not arranged across the complete range of the palm side and/or the back side of the hand, but in individual pieces. For example, by omitting the range of the finger joints the flexibility of the fingers can be improved when wearing a glove of the present invention. Additionally, inserting a ventilation mesh or a light fabric in the areas without the coating provides an improved ventilation of the hand. Furthermore, the layer system 50 can be adapted to the forces experienced by the hand and/or the fingers by varying the number of the layers and their thicknesses. By different textures at different areas of the palm side and of the fingers, respectively, it is possible to optimize the grip of the sports glove. It is also possible to adapt the layer system 50 individually to the wishes and requirements of a single wearer.

[0047] In a further embodiment foamed PUR material and conventional latex foam material can be combined in a coating. For example, a sports glove can be made having at the palm side a latex foam material based coating, but not at the back side of the hand. At the outer surface the layer system 50 can be arranged. This embodiment is beneficial, since the back side of the hand is often more susceptible to latex foam material than the palm side.

[0048] In the following, the composition and the manufacture of an embodiment with three layers of an inventive layer system 50 for a sports glove is described.

[0049] In a first step, PUR systems are prepared for three layers 30, 35 and 40. The following materials with the given

mass ratios are used to produce a foam material for a first layer 30 with a density of 0.3 g/cm^3: PUR dispersion (e.g. Impranil® of Bayer AG) 1000 g, stabilising agents (e.g. Stokal® of Stockhausen GmbH) 35 g, cross linking agents 10 g, thickening agents 23 g, foaming agents (e.g. ammonia solution) 5 g, and colour pigments (e.g. Euterm® of Bayer AG) 53g.

[0050] The PUR system of the second layer 35 which is foamed to a density of 0.5 g/cm^3 differs from the PUR system of the first layer 30 simply by using two raw materials for the PUR dispersion (e.g. Impranil® of the Bayer AG and Impraperm® of Bayer AG with a ratio of 3:2).

[0051] For the PUR system of the tie-coat 40, which is foamed to a density of greater than 0.5 g/cm^3, the following materials are used with the mass ratios given: PUR dispersion 1000 g, thickening agents 15 g, and foaming agents 5 g.

[0052] In a second step, the three PUR systems are separately mechanically foamed by mixing air into them. By varying the amount of mixed air, the pore size of the different layers as well as their density can be adjusted. As already described above, the tie-coat 40 can alternatively be chemically foamed, whereby the pores at the outer surface 45 of the tie-coat 40 are substantially closed.

[0053] In the next step, the layer 30 is arranged to the backing layer 25 with a coating knife. The wet gap determines the mass add-on of the applied PUR foam material. Consequently, the PUR foam material add-on is dried, i.e. the water content contained in the PUR foam is vaporized. In doing so, as already explained above, it is possible to reduce the water content after a first drying step at a temperature of about 75° C and in a second drying step at a temperature of about 95° C. In a third drying step at about 150° C the polyurethane-polyurea foam material of the layer 30 is cross linked in a chemical reaction to a solid layer 30. In the next step, the PUR foam of the second layer 35 is applied on the finished layer 30. This layer is then dried according to the scheme described above.

[0054] In an alternative process control, the drying process is interrupted after the first drying step and the second layer 35 is applied with a coating knife on the wet gel-like layer 30.

[0055] In a further embodiment, the drying process is interrupted after the second drying step and the second layer 35 is applied on the dried first layer 30. The second layer 35 is then dried as outlined in the context of the drying process of the first layer 30.

[0056] The tie-coat 40 can be applied, dried and cross linked analogue to the application and drying processes explained above for the layers 30 and 35. The cross linking reaction of the layers 30, 35 and 40 occurring during the third drying step is preferably carried out in common to optimize the cross linking of the different layers amongst each other.

[0057] The following table shows the results of Martindale abrasion tests executed at a layer system 50 which is composed of three layers 30, 35 and 40. The results of a comparable latex foam material coating are given in the third column of the table. Both coatings have the same thickness and have a smooth outer surface 45. At the first abrasion test a standard textile SM 25 was used as a counterpart and at the second abrasion test a flexible sandpaper with the grain P 400 was used.

Table 1: Comparison of abrasion tests

	PUR layer system 50	Latex foam material
Thickness of layer system	2.6 mm	2.6 mm
Number of layers	3	1
Density	0.28 g/cm^3	0.24 g/cm^3
Surface structure	smooth	smooth
Martindale-Abrasion tests		
Textile - SM 25	800 cycles: little abrasion	200 cycles: high abrasion
Sandpaper - P 400	800 cycles: Little abrasion	200 cycles: High abrasion

[0058] At both tests, the latex foam material coating shows after 200 cycles a significantly larger abrasion than the PUR layer system 50 after 800 cycles. The results of these measurements show the significant improvement to the wear resistance of sports gloves having a PUR layer system 50 in comparison with gloves having a coating based on latex foam material. As already mentioned, at the same time the grip of both coatings is comparable. In particular, in wet conditions the grip of a PUR layer system 50 is significantly improved compared to latex foam material.

Claims

1. Sports glove, in particular a goal keeper glove with a layer system (50) comprising at least one layer (30, 35, 40) of

foamed polyurethane-polyurea.

2. Sports glove of claim 1, wherein the at least one layer (30, 35, 40) is arranged at an outside of the glove.

3. Sports glove of any of the preceding claims, further comprising at least one further layer (35, 40) of foamed polyurethane-polyurea.

4. Sports glove of any of the preceding claims, further comprising at least one tie coat (40) of foamed polyurethane-polyurea arranged on the at least one layer (30, 35) or the at least one further layer (35).

5. Sports glove of any of the preceding claims, wherein the at least one layer (30, 35, 40) or the at least one tie coat (40) comprises at its outer surface (45) a three dimensionally shaped texture.

6. Sports glove of any of the preceding claims, wherein the at least one layer (30, 35, 40) is arranged at the palm side and / or the back side of the hand of the glove.

7. Sports glove of any of the preceding claims, wherein the layer system (50) comprises a thickness of 0.1 mm to 10 mm, preferably of 0.2 mm to 5 mm, and particularly preferred of 0.3 mm to 3.5 mm.

8. Sports glove of any of the preceding claims, wherein the layer system (50) comprises at least one layer (30, 35, 40) and least one further layer (30, 35) and wherein the at least one layer (30, 35) of foamed polyurethane-polyurea comprises a thickness of 0.4 mm to 6 mm, preferably of 0.6 mm to 4.4 mm and particularly preferred of 0.8 mm to 3.5 mm.

9. Sports glove of one of the preceding claims, wherein the at least one tie coat (40) of foamed polyurethane-polyurea comprises a thickness of 0.1 mm to 2 mm, preferably 0.2 mm to 1 mm and particularly preferred of 0.3 mm to 0.5 mm.

10. Sports glove of any of the preceding claims, further comprising at least one backing layer (15, 20, 25).

11. Sports glove of any of the preceding claims, wherein the material for the at least one backing layer (15, 20, 25) of a layer composition (10) comprises a plastic, in particular a polyurethane foam, a three dimensional knit fabric, a woven fabric of natural or artificial material, and/or leather.

12. Sports glove of any of the preceding claims, wherein foamed polyurethane-polyurea for the at least one layer (30, 35) is mechanically foamed by adding air in a mixture of materials comprising at least the following constituents:

    a polyurethane-polyurea dispersion, a stabilizing agent, a cross linking agent, a thickening agent, and a foaming agent.

13. Sports glove of one of claims 1 - 11, wherein foamed polyurethane-polyurea for the at least one tie coat (40) is mechanically foamed by adding air in a mixture of materials comprising at least the following constituents:

    a polyurethane-polyurea dispersion, a thickening agent, and a foaming agent.

14. Sports glove of any of the preceding claims, wherein the outer surface (45) of the layer system (50) has substantially open pores due to mechanically foaming of the polyurethane-polyurea of the tie coat (40).

15. Sports glove of any of the preceding claims, wherein at least the outer surface (45) of the layer system (50) has substantially closed pores due to chemically foaming of the polyurethane-polyurea of the tie coat (40).

16. A method for manufacturing a layer system (50) for a sports glove of any of the preceding claims, wherein a first layer (30, 35) of foamed polyurethane-polyurea is transformed into a wet gel-like condition by a first temperature step before applying a second layer (35, 40) of foamed polyurethane-polyurea.

Figure 1

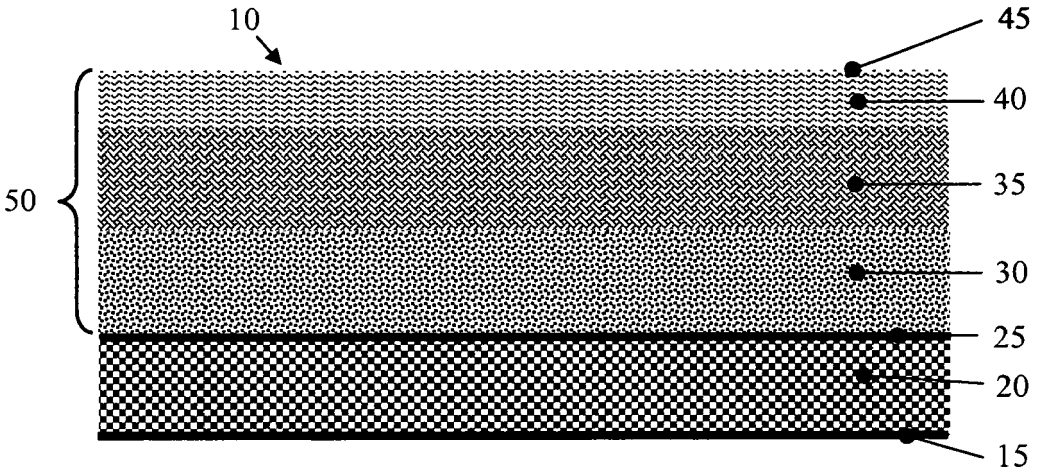


Figure 2a

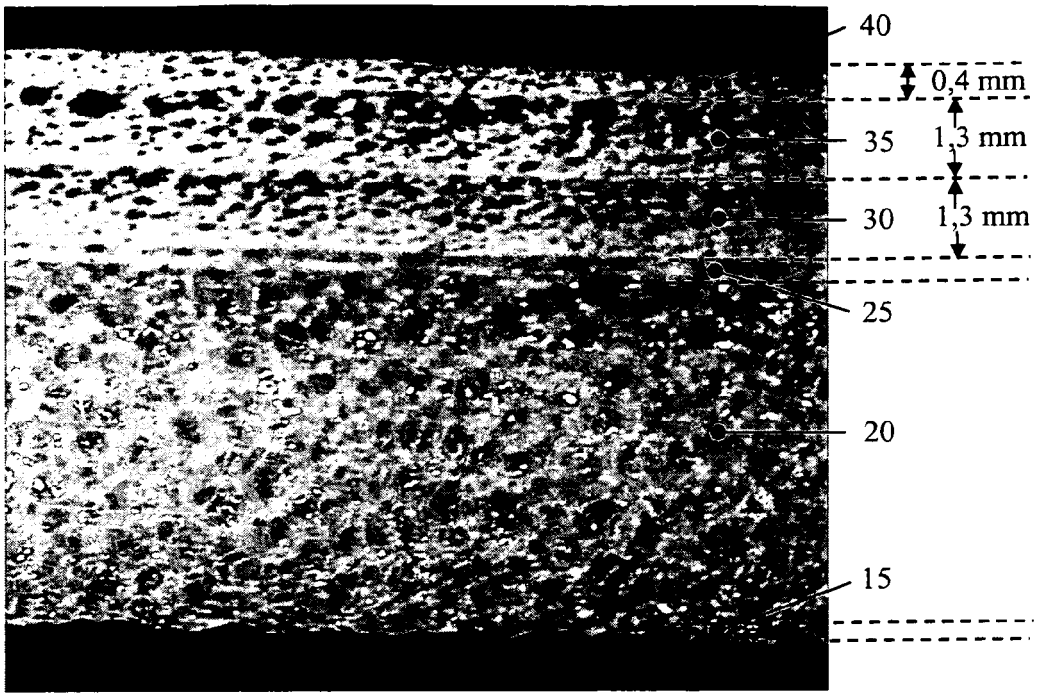


Figure 2b

Figure 3a

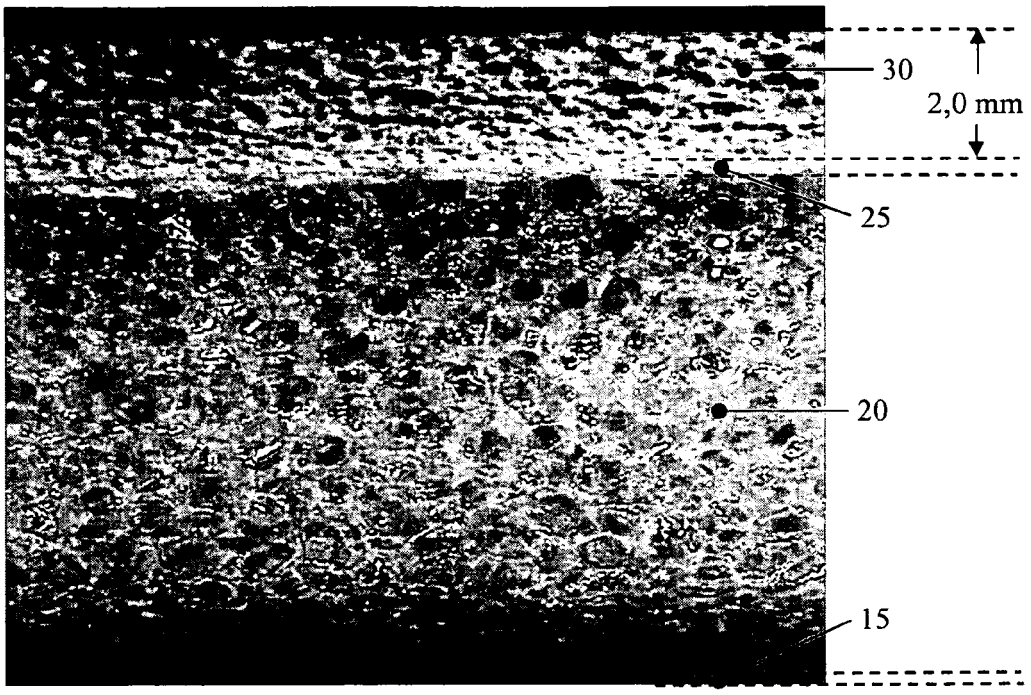
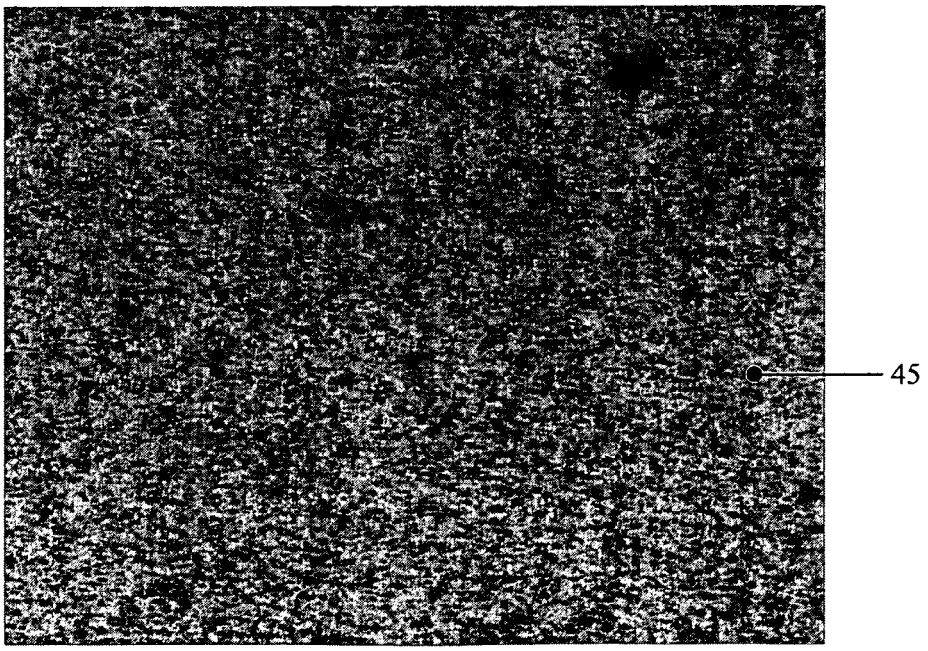


Figure 3b



REFERENCES CITED IN THE DESCRIPTION

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