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(54) **A SHOE, AND A METHOD OF MANUFACTURING A SHOE**

(57) A shoe comprising a sole, with a ground-engaging surface for engaging the ground; an edge; and a connecting portion interconnecting and extending between the ground-engaging surface and the edge is provided. At least one the sole, edge and connection portion comprises a first material and a second material, wherein the first material comprises at least one polymer and/or copolymer, wherein the at least one polymer and/or copolymer is selected from the group comprising rubber, polyurethane (PU), thermoplastic polyurethane (TPU), thermoplastic elastomers (TPEs) and Thermoplastic rubbers (TPR) such as ethylene propylene diene monomer rubber (EPDM rubber), styrene-butadiene rubber (SBR), polyvinylchloride (PVC), ethylene-vinyl acetate (EVA), polyethylene such as ultra-high-molecular-weight polyethylene (UHMW-PE), synthetic rubbers, such as styrene-butadiene rubber (SBR), Styrene Butadiene Styrene, nylon or mixtures thereof with a Shore D hardness 40 or higher, and wherein the first material further comprises an additional material selected from the list comprising polymerized polysiloxanes such as polymerized silicone, polyethylene such as ultra-high molecular (UHMW) siloxane polymer, per- and polyfluoroalkyls (PFAS) such as polytetrafluoroethylene (PTFE), graphene, graphite or mixtures thereof.

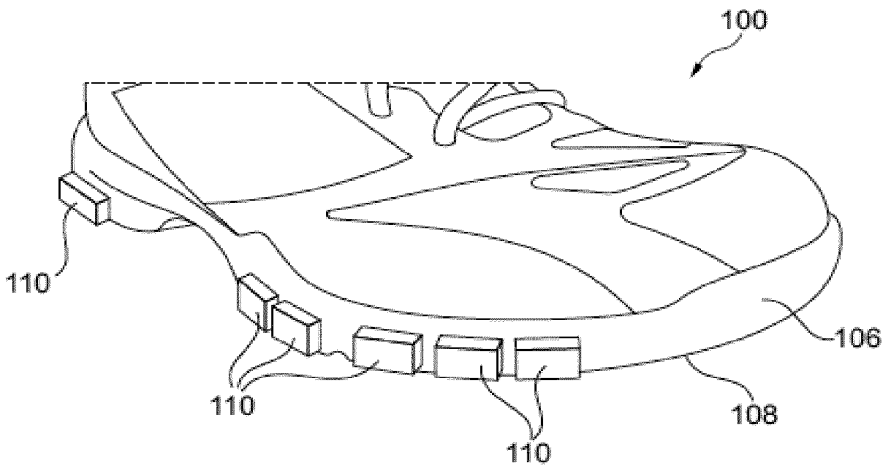

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a shoe, such as a sport shoe, tailored to reduce the risk of injuries, compensate disability and enhance performance. The invention also relates to a method of manufacturing a shoe.

BACKGROUND OF THE INVENTION

[0002] It has been estimated that ankle injuries account for 15-30% of all injuries in sport.

[0003] An estimated 70-80% of athletes who suffer a sprain will have repeated problems. Functional ankle instability and sprains reoccur in about 10-60 % of athletes previously subject of acute injury. In these patients a part of the mechanism that causes re-injury is an erroneous sensation of the position of the ankle joint in plantar flexion 30°/inversion 20° whereby the joint can be more plantar-flexed and inverted when landing thus creating a risk of lateral distortion.

[0004] Ankle injuries typically occur when the ankle twists uncontrolled in an inversion/supination and possibly plantar flexion motion. This results in a lateral sprain (distortion) but fractures also occur frequently. The sprain causes damage to the calcaneofibular ligament and the talofibular anterior ligament in varying degrees and possibly the tibiofibular anterior ligament as well as the joint capsule and surrounding soft tissue.

[0005] The injuries can also be treated with taping or semi rigid braces but both methods have significant limitations as they provide a limited support especially for repeated injuries and often degrades freedom of movement for the wearer. Also, the restricting effect of tape is lost after varying periods of exercise (Am J Sports Med November 2010 vol. 38 no. 11 2194-2200).

[0006] From a shoe design point of view, prevention of sports injuries has hitherto generally focussed on stability increase of shoes, enhancement of foot support, as well as on improvement of anti-slip properties of shoes. Despite past efforts, it has however been found that a need remains for further development of a shoe which contributes to reducing the occurrence of sports injuries, notably ankle and knee injuries.

[0007] International patent publication No. WO 2016/207381 discloses a shoe having an area of reduced friction with a view to reducing the ability of the user's foot to rotate relative to ground (inversion and internal rotation) when the load of the user's body is shifted towards or lands near an edge of the shoe.

[0008] The invention is developed to prevent falls, which globally are a major public health problem for people with various gait impairments (disabilities, diseases, age, pressure related pain, overuse injuries) and often has many consequences for both the individual and the public. The personal consequences can be fractures which results in long recoveries, and a worsening of life quality. In some cases, a fall can even result in fatality due to head trauma or long recoveries. Besides the personal consequences, treatment of a fall has high costs for society and the healthcare system.

[0009] Falls often occur due to tripping, which is characterized by unanticipated increased braking force in the anterior region of the shoe and sole. This typically happens when taking a short step or hitting the ground with the tip of the shoe when correcting your walk as a result of a disruption. The resulting brake force results in overbalance. If the brake force reaches a certain threshold, there is no longer a possibility for regaining control over your balance, which will result in a fall.

[0010] In some gait impairments a plantar flexion and inverted foot position is seen, which results in an anterior and lateral pressure distribution during foot strike. This gait pattern will, besides the increased risk of falling, also cause pain in the foot due to the high plantar pressure.

Description of the invention

[0011] It is an object of embodiments of the invention to provide an improved shoe such as an improved sports shoe. It is in particular an object of embodiments of the invention to provide a shoe which enhances its grip relative to the ground in circumstances when a solid grip is desired, and which enhances slip relative to the ground in circumstances when low friction properties relative to the ground are desired.

[0012] So, in a first aspect the present invention relates to a shoe comprising:

- a sole, with a ground-engaging surface for engaging the ground;
- an edge; and
- a connecting portion interconnecting and extending between the ground-engaging surface and the edge, wherein at least one the sole, edge and connection portion comprises a first material and a second material,

wherein the first material comprises at least one polymer and/or copolymer, wherein the at least one polymer and/or copolymer is selected from the group comprising rubber, polyurethane (PU), thermoplastic polyurethane (TPU), thermoplastic elastomers (TPEs) and Thermoplastic rubbers (TPR) such as ethylene propylene diene monomer rubber (EPDM rubber), styrene-butadiene rubber (SBR), polyvinylchloride (PVC), ethylene-vinyl acetate (EVA), polyethylene such as ultra-high-molecular-weight polyethylene (UHMW-PE), synthetic rubbers, such as styrene-butadiene rubber (SBR), Styrene Butadiene Styrene, nylon or mixtures thereof with a Shore D hardness 40 or higher,
and wherein the first material further comprises an additional material selected from the list comprising polymerized polysiloxanes such as polymerized silicone, pol-

yethylene such as ultra-high molecular (UHMW) siloxane polymer, per- and polyfluoroalkyls (PFAS) such as polytetrafluoroethylene (PTFE), graphene, graphite or mixtures thereof.

[0013] The Shore D hardness of the first material may be 45 or high, 50 or higher, 55 or higher og 60 or higher. The first material, having a Shore D hardness or 40 or more, preferably has a low surface friction providing a friction coefficient less than 0.7, preferably less than 0.6, more preferably less than 0.55, more preferably less than 0.5, such as less than 0.45 or less than 0.4 as measured in a shoe friction test according to ISO 13287:2012.

[0014] Preferably that portion or those portions of the sole, edge and/or connecting portion of the shoe comprising the first material covers a minor portion of the outer surface of the sole, edge and/or connecting portion only. For example, the first material may be comprised only in or more elements, or islands, attached to an outer surface of the shoe or embedded in the outer surface of the shoe. If provided at the edge or connecting portion, such elements or islands may occupy less than 50% of the surface area of the edge or connecting portion of the shoe, such as less than 30%, less than 25% or less than 20%. If provided at the sole of the shoe, such elements or islands may occupy less than 30% of the surface of the sole, such as less than 25%, less than 20%, less than 15% or less than 10%. Each of the elements or one or more island portions preferably has a periphery, at least part of which is adjacent to other surface portions of the shoe made from a material having a Shore D hardness of less than 30, preferably less than 25.

[0015] In one embodiment, the first material is provided at the edges or the connecting portion of the shoe only so as to promote translational sliding of the user's foot parallel to an underlying surface during a shift of the user's weight outwardly or forwardly when no realignment of the user's body can be achieved, i.e. when a force component in a lateral or forward direction is applied. Thus, the sole of the shoe may be substantially planar with no cleats or protrusions of a material other than the sole material itself protruding therefrom. Alternatively, in a substantially planar embodiment of the sole, one or more island portions of the first material may be provided which essentially lie flush with the surrounding sole material.

[0016] The first material may be provided only on one or more island portions at the sole, edge and/or connecting portion, wherein said one or more island portions a circumferentially surrounded by a shoe material having a Shore D hardness of less than 30. The shoe material surrounding the one or more island portions may be the second material.

[0017] The one or more island portions may protrude slightly from the surrounding shoe material, or they may lie flush with the surrounding shoe material. For example, the one more island portions may protrude by at most 3 mm, such as by at most 2 mm, such as by at most 1 mm from the surrounding shoe material. Alternatively, or additionally, the one ore more island portions protrude from the surrounding shoe material by a protrusion height which is at most 1.5% of the length of the shoe, such as at most 1%, such as at most 0.7%, such as at most 0.5%.

[0018] The shoe according to the invention is preferably for promoting translational, linear movement (i.e., sliding) of the user's foot relative to ground.

[0019] According to the second aspect, the invention provides a method of manufacturing a shoe according to the first aspect of the invention, wherein: the first element is comprised in at least one insert secured to a portion of the sole of the shoe; the second element is integrated with the sole of the shoe; the sole of the shoe, except for the first element, and the second element are integrally from one and the same sole material; the method comprising the step of co-moulding or co-extruding the first element with the sole material.

[0020] In the present context, injuries should be understood to include, but not be limited to sprains, including syndesmosis ruptures, dislocations, strains, and fractures. Injuries could also be understood to include osteochondral lesions. In the context of falling prevention various trauma might result such as contusions, fractures and concussion or intracerebral haemorrhage. In the context of overuse injuries these are fasciitis, tendinitis, tendinopathies and stress fractures. Pressure related injuries and disability includes diabetic and other ulcers, osteoarthritis pain from foot, knee and hip and pain due to pes planus, overpronation and similar conditions.

[0021] In the present context, the ground-engaging surface should be understood to be that part of the shoe which engages the ground when the wearer of the shoe is standing up straight and puts equal weight on both feet. The ground-engaging surface may differ from the part of the shoe that engages the ground.

[0022] In the present context, the edge is to be understood as extending from the connecting portion in a direction away from the ground-engaging surface and the connecting portion, the edge extending in a direction transverse, i.e., not parallel, to the ground-engaging surface.

[0023] Low friction properties may be desired with a view to enable the shoe to slide parallel to its underlying surface during a shift of the user's weight outwardly or forwardly when no realignment of the user's body can be achieved, i.e. when a force component in a lateral or forward direction is applied. The amount of energy transferred to user's foot and leg anatomy and further up the kinetic chain, resulting from the shoe's ground grip may thus be reduced. In some incidents, the user may fall due to loss of grips, but the risk of general injury, however, reduces relative to the risk that would have existed if the selected portion of the shoe had maintained its grip relative to ground. In these cases, loss of grip may also enhance performance in some athletic shoes used for handball, football, floorball or dance as it allows the user to go into the splits with minimum force to overcome in an element is applied to the heel portion of the shoe.

[0024] Reduced friction may prevent ankle sprains as most sprains happen with the foot in contact with the ground during landing or other movements at which the foot interacts with ground in an unpredicted or unbalanced manner, such as when the foot lands on an opponent's foot or positions itself incorrectly relative to ground. Moreover, the selected portion when reducing friction may ensure increased mobility of the shoe when the area of reduced friction is in contact with the ground thus preventing the shoe from remaining at an undesirable position relative to ground. Instead, the shoe is enabled to slide parallel to its underlying surface or reducing undesirable translational and rotational forces such as in-/eversion of the foot, in/external rotation with sprain risk due to harmful subsequent transferral of kinetic energy to the kinetic chain and surrounding tissues and decreased sports performance due to suboptimal positioning for muscle force generation. Also, unwanted braking force on the edge of the shoe will affect performance negatively, e.g. in turning and sideways movement. Such adverse effects are diminished by the lowered friction. Accordingly, the effect will increase sliding in, e.g., tennis and enhance safety of this movement in tennis.

[0025] The first material may be included in a tip element of the shoe. This helps avoid injuries by avoiding the application of a braking force at the tip of the shoe. In particular, the tip element allows the shoe to slip over and across an obstacle, such as, e.g., a door threshold or tile edge not observed by the wearer of the shoe. To that end, the tip element preferably defines a Shore D hardness of 40 or higher polymer or copolymer, such as TPU or EPDM rubber in combination with an additional material, such as polymerized siloxane, e.g., UHMW siloxane, and preferably a coefficient of friction relative to ground lower than the coefficient of friction between the sole and ground. Thus, when a wearer's shoe collides with an obstacle, the tip element promotes that the shoe slides over the obstacle rather than being stopped in the horizontal plane. Also, in situations where an obstacle height or geometry makes it unfeasible to slide easily over the obstacle, the tip element will avoid self-locking of the shoe and convert horizontal braking force to an elevating frontal plane force thus promoting a lift of the shoe and a step over response from the wearer. In other situations, the different protective mechanisms may supplement each other.

[0026] The second material may comprise at least one polymer and/or copolymer, wherein the at least one polymer and/or copolymer is selected from the group comprising rubber, polyurethane (PU), thermoplastic polyurethane (TPU), thermoplastic elastomers (TPEs) and Thermoplastic rubbers (TPR) such as ethylene propylene diene monomer rubber (EPDM rubber), styrene-butadiene rubber (SBR), polyvinylchloride (PVC), ethylene-vinyl acetate (EVA), or mixtures thereof with a Shore A hardness 50-85.

[0027] The at least one selected portion of the sole, the edge, or the connecting portion may comprise two adjacent elements, a first one of which has first properties of the first material, and a second one of which has second properties of the second material.

[0028] The first material and second material preferably have different friction coefficients to each other so as to provide a multi-frictional composition.

[0029] The second material may be selected among conventional shoe sole materials. The method of measurement of Shore hardness measures the depth of indentation in the material created by a given force on a standardized presser foot. Shore A hardness is typically measured by an indenting foot having a hardened steel rod having 1.1 mm-1.4 mm diameter, with a truncated 35° cone and 0.79 mm diameter. The applied mass is typically 0.822 kg, which results in a force (N) of 8.064.

[0030] Shore hardness D is typically measured by an indenting foot having a hardened steel rod having 1.1 mm-1.4 mm diameter, with a truncated 30° conical point and 0.1 mm radius tip. The applied mass is typically 4.550 kg, which results in a force (N) of 44.64.

[0031] As it is understood by the skilled person, a material having a Shore Hardness A 50-85 is considered to be a softer material than a material having a Shore Hardness D 40 or higher.

[0032] The first material is considered to be low friction in comparison to the second material, which, in the context of the present invention is considered to be a high friction material in comparison with the first material.

[0033] To provide the low friction material, it is possible to provide the first material, such as TPU having a Shore Hardness D 40 or higher in combination with polymerized siloxanes, such as polymerised silicone. However, it is also possible to provide a first material, such as TPU having a Shore Hardness D 40 or higher in combination with graphene and/or PTFE to provide the low friction material. Accordingly, the first material may be provided such that silicone is absent and only e.g., PTFE and/or graphene is present.

[0034] Due to the first and second material having different friction coefficients, a multi-frictional composition is provided. The multi-frictional composition typically comprises the first material having first friction properties and the second material having second friction properties. Preferably, as mentioned above, the first material has a friction coefficient less than 0.7, less than 0.6, less than 0.55, less than 0.5, less than 0.45 or less than 0.4 as measured in shoe friction test (ISO 13287:2012). The second material has a coefficient of friction higher than that of the first material, preferably of more than 0.7 as measured in shoe friction test (ISO 13287:2012).

[0035] The first material has a shore D hardness of 40 or more as defined by ASTM 2240. An example of such suitable first material is Elastollan® 1174D (BASF Chemical Company), which has a Shore D hardness of 74.

[0036] The weight% of the first material may be between about 10-30% based on the total weight of the polymer composition. The weight% of the additional material may be between about 5-30% based on the total

weight of the first material, preferably about 15-25%, more preferably about 20-22% and most preferably about 20% based on the total weight of the first material.

[0037] An example of an additional material is MB 50-017 Masterbatch (Dow Corning®) which comprises 50% of ultra-high-molecular-weight (UHMW) siloxane polymer dispersed in thermoplastic polyurethane (TPU) but other suitable commercially available materials may also be used.

[0038] In some embodiments, the composition comprises e.g., TPU having Shore hardness D 40 or higher and e.g., UHMW siloxane polymer.

[0039] The second material and the sole of the shoe may be integrally formed from one and the same sole material. The first material may have a lower surface friction than the second material.

[0040] In the present context, a sports shoe may be understood as a shoe suitable for wear when engaging in various forms of indoor and/or outdoor sports activities such as football, basketball, volleyball, handball, floorball, tennis, badminton, dancing, table tennis, fitness, etc. Such shoe may also be referred to as an athletic shoe.

[0041] In the context of the present invention, the shoe may also be a safety shoe, a casual shoe or an orthopaedic shoe.

[0042] The shoe may define a foot part and a leg part, wherein the leg part extends no longer than a distance equal to one third of the distance from a wearer's knee to the farthest end of the wearer's heel. In this case, the shoe may be particularly suitable for use as a sports shoe because it may allow sufficient limb mobility for the wearer of the shoe to perform sports. In the present context, the foot part is to be understood as the part of the shoe encompassing the wearer's foot. The leg part is to be understood as the part of the shoe vertically extending between the surface of the wearer's heel furthest from the wearer's knee and the part of the shoe closest to the wearer's knee. As such, the foot part and the leg part of the shoe overlap.

[0043] The shoe may define a foot part and a leg part, wherein the leg part extends no longer than 1.25 times the longest straight-line extend of a wearer's foot. Thus, the height of the leg part is thus at most equal to 1.25 times the length of the foot part, or at most equal to the length of the foot part, or smaller than then length of the foot part. The height of the leg part is preferably measured as a straight-line distance from the bottom of the sole of the shoe to an uppermost edge of the shoe for circumferentially surrounding the wearer's leg. In such embodiments, the shoe may be particularly suitable for use as a sports shoe because it may allow sufficient limb mobility for the wearer of the shoe to perform sports. In present context, the foot part is to be understood as the part of the shoe encompassing the wearer's foot. The leg part is to be understood as the part of the shoe vertically extending between the surface of the wearer's heel furthest from the wearer's knee and the part of the shoe closest to the wearer's knee. As such, the foot part and the leg part of the shoe overlap. The longest straight-line extend of the wearer's foot is commonly equal to the distance between the furthest ends of the wearer's toes and heel parallel to ground when the wearer is standing up.

[0044] It should be understood that the first coefficient of friction may be different for different parts of an outwardly facing surface of the shoe. The friction coefficient may gradually change within the outwardly facing surface(s).

[0045] One benefit of embodiments of the invention may be the prevention of fall due to decreased braking forces, and the direction of the remaining force upwards over a potential object and lastly the limitation of inappropriate braking force in the anterior-lateral sole portion while full push-off traction may advantageously be preserved.

[0046] Abnormal gait patterns may be corrected due to increased pressure in the anterior-lateral regions by backwards pressure distribution, medially and more evenly, thereby improving the gait pattern and reducing the risk of pain and overuse injury.

[0047] Likewise, similar undesirable pressure can be distributed appropriately in other abnormal gait patterns. Also, this technique applies to alleviating unwanted pressure distribution in overuse injuries, pain conditions and ulcers.

[0048] With and outward directed force such as in the push off the higher friction elements may deflect in a direction that ensures they remain in contact with the ground to thereby preserve traction and prevent slipping.

[0049] The first material of the sole, the edge, or the connecting portion may generally be provided on a resilient backing structure for biasing the shoe away from ground in a backward movement of the shoe. This may further facilitate lifting of the shoe.

[0050] The first material of the sole, the edge or the connecting portion may be arranged at a lateral side edge of the shoe. This may lower the risk of lateral distortion.

Brief description of the drawings

[0051] Embodiments of the invention will now be further described with reference to the drawings, in which:

Fig. 1 illustrates an embodiment of a shoe,

Fig. 2 illustrates a part of an embodiment of a shoe,

Figs. 3-4 illustrate an embodiment of a shoe with a tip element.

Detailed description of the drawings

[0052] It should be understood that the detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to

those skilled in the art from this detailed description.

[0053] Fig. 1 illustrates an embodiment of a shoe 100 and Fig. 2 illustrates a part of the shoe 100 seen from below. The shoe 100 comprises a sole 102 with a ground-engaging surface 104 for engaging a ground (not shown), an edge 106, and a connecting portion 108 interconnecting and extending between the ground-engaging surface 104 the edge 108.

[0054] At least one selected portion of the sole 102, the edge 106, or the connecting portion 108 comprises an element 110 having first material properties

The element 110 may be comprised in at least one insert 114 which may be secured to a portion of the sole 102 of the shoe 100. The illustrated insert 114 forms two outwardly facing surfaces 116, one defining a portion of an outer surface of the sole, and one defining a portion of the edge of the shoe (not shown in Figs. 3a-3c).

[0055] Surface 116 provides a relatively low surface friction. Conversely, the outer surface of the sole has a higher coefficient of friction, which enables the selected portion's grip relative to the ground being enhanced in circumstances where high friction properties are desired, and surface 116 enables a lower coefficient of friction in circumstances where low friction properties are desired. This allows for relative low friction in laterally directed movements. The decrease in inversion moment decreases the risk of e.g. ankle injury and the lesser translational force facilitates easier rotational movement and further decreased risk of anterior cruciate injury.

[0056] The reduced maximum friction and pressure can tailor the preventive effect in e.g. anterior cruciate injuries as a result of the maximum moment around the foot being decreased. In certain areas of the shoe, it can, e.g., prevent fatigue fractures, overuse injuries and pressure ulcers.

[0057] Sole 116 can also compensate disability in dropfoot, clubfoot, cerebral paresis and other gait impairments by reducing abnormal pressures and directing these, e.g., medially and posteriorly to achieve better gait stability.

[0058] Figs. 3-4 illustrate an embodiment of a shoe 300 with a tip element 304 made from a first material and a sole 302 made from a second material. The second material may be a second material as specified in the appended claims. Fig. 3 illustrates a front-end view of the shoe, and Fig. 4 shows a cross section along line A-A in Fig. 3. The tip element 304 provides safety feature allowing the shoe to slip over and across an obstacle, such as, e.g., a threshold not observed by the wearer of the shoe. To that end, the tip element 304 preferably defines a Shore D hardness of 40 or higher polymer or copolymer, such as TPU or EPDM rubber in combination with an additional material, such as polymerized siloxane, e.g., UHMW siloxane as specified in the claims, and preferably a coefficient of friction relative to ground lower than the coefficient of friction between the sole 302 and ground. Thus, when a wearer stumbles over an obstacle, the tip element 304 promotes that the shoe tends to slide over and across the obstacle rather than engaging it due to friction.

[0059] The tip element 304 covers at least an edge portion 306 of the shoe 300 in the tip region 308 of the shoe 302. As shown, the tip element 304 may extend into a vamp portion 310 of the shoe and/or into a toe cap portion 312 of the shoe. In one embodiment, the tip element 304 constitutes a toe cap. The tip element 304 may be integrated with the vamp portion 310 and/or with the toe cap portion 312, or it may be provided as an element adhered to the shoe, such as, e.g., by gluing, such as, e.g., a retrofitted element. The tip element 304 may cover only a tip or toe region of the shoe, as shown in Figs. 3-4, or alternatively it may extend into the sole 302. In the embodiment show, the tip element 304 defines a first, forwardly facing portion 304a and a second upwardly facing portion 304b. In embodiments, in which the tip element 304 has a sole portion (not shown) extending into the sole 302 of the show, the upwardly facing portion 304 may optionally be dispensed with. In the embodiment shown, a lower edge 304c of the forwardly-facing portion 304a forms a continuation of the sole 302, so that the lower edge 304c lies flush with and/or extends in continuous continuation of the sole. At a transition between the forwardly-facing portion 304a and the upwardly-facing portion 304b, the tip element 304 may form an angle of between 75 and 105°. The forwardly-facing portion 304a may extend in a forward direction relative to vertical at an angle of 1-15°, such as at an angle of 2-10°.

[0060] It should be understood that a skilled person would readily recognise that any feature described in combination with the first aspect of the invention can also be combined with the second aspect of the invention, and vice versa. The remarks set forth above in relation to the shoe are therefore equally applicable in relation to the method.

[0061] A manufacturing process is therefore provided for a shoe comprising a first material and a second material according to the invention.

EXAMPLES

EXAMPLE 1

[0062] A manufacturing process for a shoe comprising a first material and a second material according to the invention.

[0063] A first material, 'hard' TPU with a Shore hardness D 40 or above (Elastollan® 1174D, BASF Chemical Company) with a siloxane polymer (such as Dow Corning® MB50-017 Masterbatch) is provided with a second material, 'soft'TPU is provided with a Shore hardness A 65 (Compound PYV RB 02 (065) from PY KG), in a compounder and was compounded according to the manufacturer's instructions.

[0064] The raw material was dried for 45 minutes in 80° vacuum.

[0065] The first and second material is then moulded

using an aluminium resin. The moulding was conducted with an injection pressure of 50 bar and 10 cm^3/s injection speed. The back pressure was set to 20 bar at 4 s back pressure time. The nozzle temperature was set to be 215 °C, with the front, middle and back nozzle set to 205 °C, 205 °C and 205 °C, respectively. A cooling time of 8 s was provided.

EXAMPLE 2

[0066] A manufacturing process for a shoe comprising a first material and a second material according to the invention.

[0067] A first material, 'hard' TPU with a Shore hardness D 40 or above (Elastollan® 1174D (BASF Chemical Company) with a siloxane polymer (Dow Corning® MB50-017 Masterbatch) is provided with a second material, 'soft' TPU is provided with a Shore hardness A 65 (Compound PYV RB 02 (065) from PY KG), in a compounder and was compounded according to the manufacturer's instructions.

[0068] The raw material was dried for 45 minutes in 80° vacuum.

[0069] The first and second material is then moulded using an aluminium resin. The moulding was conducted with an injection pressure of 45 bar and 6 cm^3/s injection speed. The back pressure was set to 45 bar at 5s back pressure time. The nozzle temperature was set to be 225 °C, with the front, middle and back nozzle set to 220 °C, 215 °C and 215 °C, respectively. A cooling time of 20 s was provided.

EXAMPLE 3

[0070] A manufacturing process for a shoe comprising a first material and a second material according to the invention.

[0071] A first material, 'hard' TPU with a Shore hardness D 40 or above (Elastollan® 1174D (BASF Chemical Company) with a siloxane polymer (Dow Corning® MB50-017 Masterbatch) is provided with a second material, 'soft' TPU is provided with a Shore hardness A 65 (Compound PYV RB 02 (065) from PY KG), in a compounder and was compounded according to the manufacturer's instructions.

[0072] The raw material was dried for 45 minutes in 80° vacuum.

[0073] The first and second material is then moulded using an aluminium resin. The moulding was conducted with an injection pressure of 35 bar and 20 cm^3/s injection speed. The back pressure was set to 30 bar at 4s back pressure time. The nozzle temperature was set to be 230 °C, with the front, middle and back nozzle set to 225 °C, 220 °C and 220 °C, respectively. A cooling time of 30 s was provided.

Claims

1. A shoe comprising:

a sole, with a ground-engaging surface for engaging the ground;
an edge; and
a connecting portion interconnecting and extending between the ground-engaging surface and the edge,
wherein at least one of the sole, edge and connection portion comprises a first material and a second material, wherein the first material comprises at least one polymer and/or copolymer, wherein the at least one polymer and/or copolymer is selected from the group comprising rubber, polyurethane (PU), thermoplastic polyurethane (TPU), thermoplastic elastomers (TPEs) and Thermoplastic rubbers (TPR) such as ethylene propylene diene monomer rubber (EPDM rubber), styrene-butadiene rubber (SBR), polyvinylchloride (PVC), ethylene-vinyl acetate (EVA), polyethylene such as ultra-high-molecular-weight polyethylene (UHMW-PE), synthetic rubbers, such as styrene-butadiene rubber (SBR), Styrene Butadiene Styrene, nylon or mixtures thereof with a Shore D hardness 40 or higher,
and wherein the first material further comprises an additional material selected from the list comprising polymerized polysiloxanes such as polymerized silicone,
polyethylene such as ultra-high molecular (UHMW) siloxane polymer, per- and
polyfluoroalkyls (PFAS) such as polytetrafluoroethylene (PTFE), graphene, graphite or mixtures thereof.

2. A shoe according to claim 1, wherein the first material is included in a tip element of the shoe.

3. A shoe according to claim 1 or 2, wherein the first material is provided at the edges of the shoe only.

4. A shoe according to any of the preceding claims, wherein the first material has a friction coefficient less than 0.7as measured in a shoe friction test according to ISO 13287:2012

5. A shoe according to any of the preceding claims, wherein the first material is provided only on one or more island portions at the sole, edge and/or connecting portion, wherein said one or more island portions, each of the one or more island portions having a periphery, at least part of which is adjacent to other surface portions of the shoe made from a material having a Shore D hardness of less than 30.

6. A shoe according to any of the preceding claims, wherein said one or more island portions protrude from the surrounding shoe material, and wherein:

- said one more island portions protrude by at most 3 mm from the surrounding shoe material, and/or
- said one ore more island portions protrude from the surrounding shoe material by a protrusion height which is at most 1.5% of the length of the shoe.

8. A shoe according to any of the preceding claims, wherein the sole of the shoe is substantially planar with no cleats or protrusions protruding therefrom.

9. A shoe according to any of the preceding claims, wherein the second material comprises at least one polymer and/or copolymer wherein the at least one polymer and/or copolymer is selected from the group comprising rubber, polyurethane (PU), thermoplastic polyurethane (TPU), thermoplastic elastomers (TPEs) and Thermoplastic rubbers (TPR) such as ethylene propylene diene monomer rubber (EPDM rubber), styrene-butadiene rubber (SBR), polyvinylchloride (PVC), ethylene-vinyl acetate (EVA), or mixtures thereof with a Shore A hardness 50-85.

10. A shoe according to any of the preceding claims, wherein the shoe material surrounding said one or more island portions is made from the second material.

11. A shoe according to any of the preceding claims, wherein at least one selected portion of the sole, the edge, or the connecting portion comprises two adjacent elements, a first one of which has first properties of the first material, and a second one of which has second properties of the second material.

12. The shoe according to any one of the preceding claims, wherein the weight% of the first material is between about 10-30% based on the total weight of the polymer composition.

13. The shoe according to any one of the preceding claims, wherein he weight% of the additional material is between about 5-30% based on the total weight of the first material, preferably about 15-25%, more preferably about 20-22% and most preferably about 20% based on the total weight of the first material.

14. The shoe according to any one of the preceding claims, wherein the first material has low friction properties and wherein the second material has high friction properties.

15. A method of manufacturing a shoe according to any of claims 4-9, wherein:

- the first element is comprised in at least one insert secured to a portion of the sole of the shoe;
- the second element is integrated with the sole of the shoe;
- the sole of the shoe, except for the first element, and the second element are integrally from one and the same sole material;

the method comprising the step of co-moulding or co-extruding the first element with the sole material.

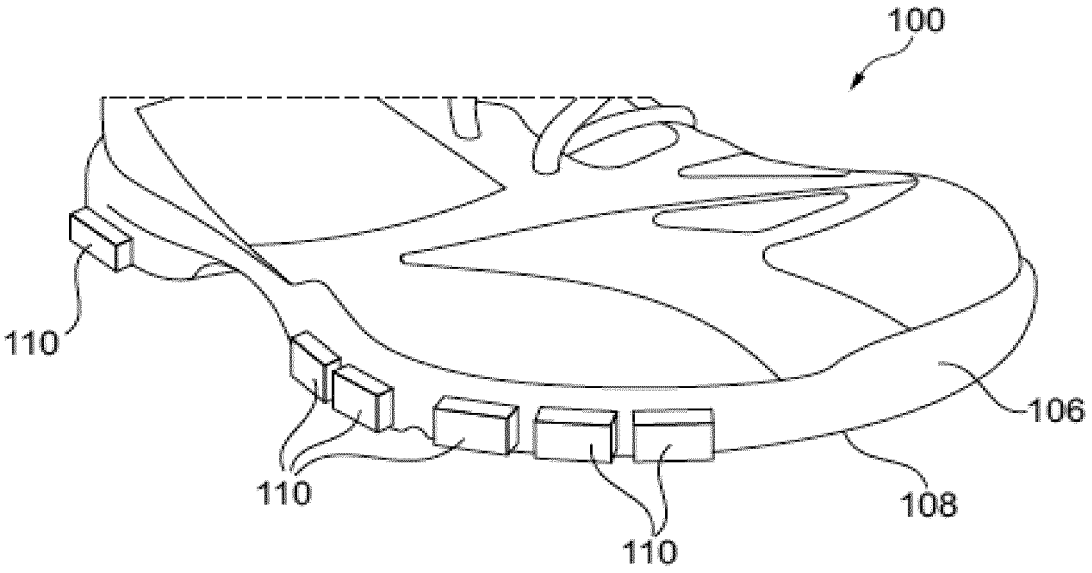

Fig. 1

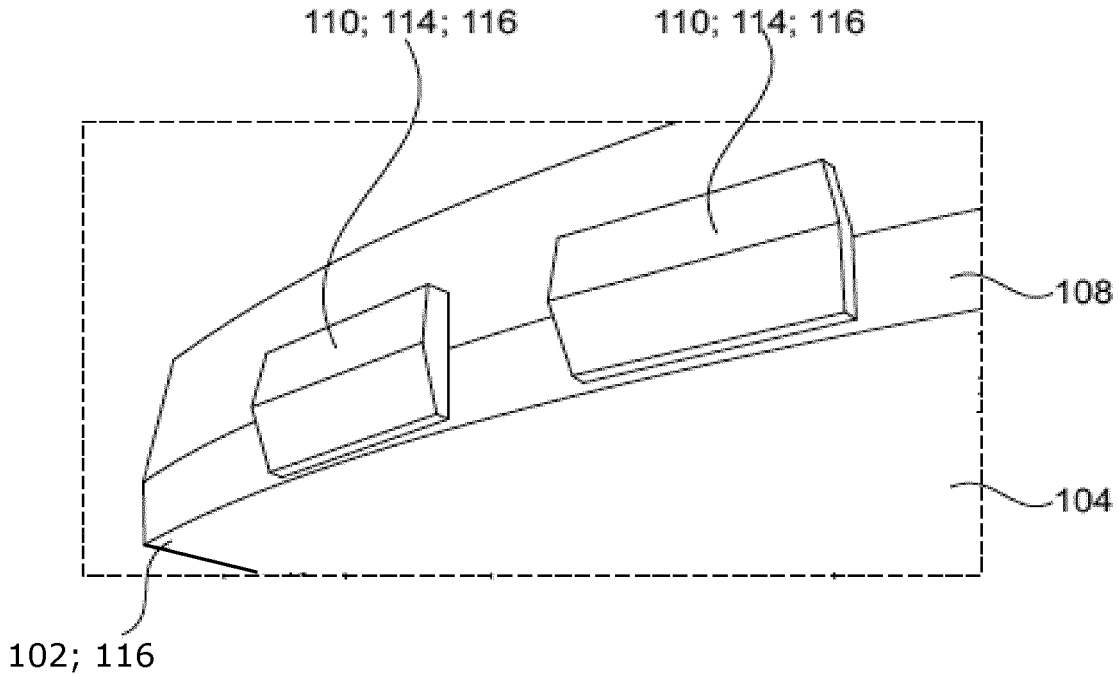

Fig. 2

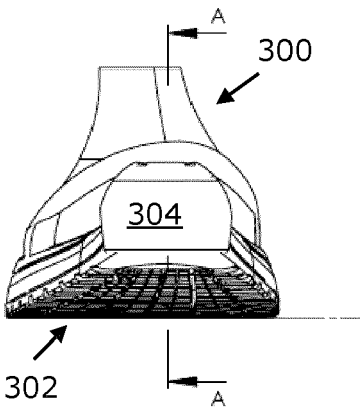

Fig. 3

A-A

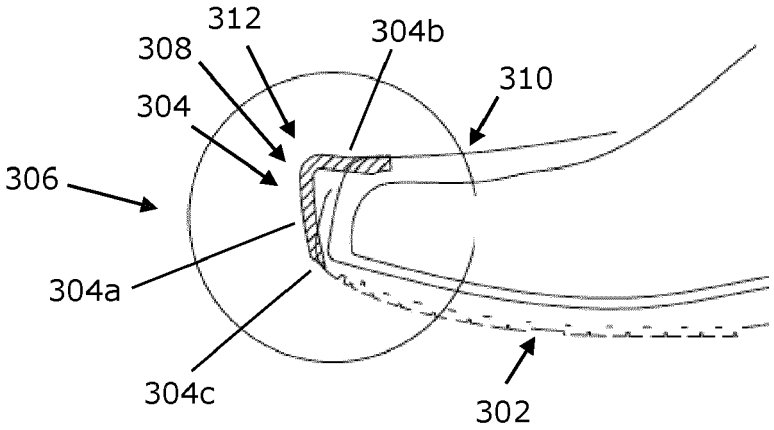

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 6421

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	21 March 2024	Chirvase, Lucian

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