A sole structure includes an outsole having an outsole forefoot region, an outsole heel region, and an outsole midfoot region between the outsole heel region and the outsole forefoot region. The sole structure further includes a midsole secured to the outsole and a shank secured to the midsole and disposed between the midsole and the outsole. The shank has an asymmetrical shape and is at least partially made of a material that is stiffer than the materials forming the outsole and the midsole.
SOLE STRUCTURE FOR AN ARTICLE OF FOOTWEAR INCLUDING A SHANK

TECHNICAL FIELD

[0001] The present disclosure generally relates to a sole structure for an article of footwear.

BACKGROUND

[0002] Footwear typically includes a sole configured to be located under a wearer’s foot to space the foot away from the ground or floor surface. Soles can be designed to provide a desired level of cushioning. Athletic footwear in particular sometimes utilizes polyurethane foam or other resilient materials in the sole to provide cushioning. The ground contact surface of the article of footwear can be configured for durability. For example, an outsole of a durable material, such as rubber, is sometimes provided at the ground contact surface of the article of footwear.

SUMMARY

[0003] It is useful to enhance the stability of a sole structure of an article of footwear around a midfoot region in order to aid the wearer to effectively transfer power from his body to a golf club during a golf swing. To this end, the present disclosure describes a sole structure including features that effectively enhance the stability of an article of footwear at its midfoot region. In an embodiment, the sole structure includes an outsole having an outsole forefoot region, an outsole heel region, and an outsole midfoot region between the outsole heel region and the outsole forefoot region. The sole structure further includes a midsole secured to the outsole. In addition, the sole structure includes a shank secured to the midsole and disposed between the midsole and the outsole. The shank has an asymmetrical shape and is at least partially made of a material that is stiffer than the materials forming the outsole and the midsole. Further, the shank includes a shank body and a plurality of legs extending from the shank body. In an embodiment, the shank is made of carbon composite. At least one of the legs is obliquely angled relative to a longitudinal outsole axis defined along the outsole.

[0004] “A,” “an,” “the,” “at least one,” and “one or more” are used interchangeably to indicate that at least one of the item is present; a plurality of such items may be present unless the context clearly indicates otherwise. All numerical values of parameters (e.g., of quantities or conditions) in this specification, including the appended claims, are to be understood as being modified in all instances by the term “about” whether or not “about” actually appears before the numerical value. “About” indicates that the stated numerical value allows some slight imprecision (with some approach to exactness in the value; approximately or reasonably close to the value; nearly). If the imprecision provided by “about” is not otherwise understood in the art with this ordinary meaning, then “about” as used herein indicates at least variations that may arise from ordinary methods of measuring and using such parameters. In addition, a disclosure of a range is to be understood as specifically disclosing all values and further divided ranges within the range.

[0005] The terms “comprising,” “including,” and “having” are inclusive and therefore specify the presence of stated features, steps, operations, elements, or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, or components. Orders of steps, processes, and operations may be altered when possible, and additional or alternative steps may be employed. As used in this specification, the term “or” includes any one and all combinations of the associated listed items.

[0006] Those having ordinary skill in the art will recognize that terms such as “above,” “below,” “upward,” “downward,” “top,” “bottom,” etc., are used descriptively for the figures, and do not represent limitations on the scope of the present teachings, as defined by the claims.

[0007] The above features and advantages and other features and advantages of the present teachings are readily apparent from the following detailed description of the best modes for carrying out the present teachings when taken in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a schematic bottom view of a sole structure of an article of footwear;

[0009] FIG. 2 is a schematic top view of the sole structure of FIG. 1;

[0010] FIG. 3 is a schematic side view of the sole structure of FIG. 1, showing the lateral side of the sole structure;

[0011] FIG. 4 is a schematic cross-sectional side view of the sole structure of FIG. 1, taken along section line 4-4 of FIG. 1; and

[0012] FIG. 5 is a schematic cross-sectional front view of the sole structure of FIG. 1, taken along section line 5-5 of FIG. 1.

DETAILED DESCRIPTION

[0013] Referring to the drawings, wherein like reference numbers refer to like components throughout the views, FIGS. 1-3 schematically illustrate an article of footwear 10 including a sole structure 12 and a footwear upper 14 (FIG. 3) secured to the sole structure 12. As a non-limiting example, the article of footwear 10 may be a golf shoe 11. The sole structure 12 includes an outsole 16 and a midsole 18 secured to the outsole 16. The outsole 16 includes an outsole body 20 and a plurality of tread elements 22 for providing traction to the wearer of the article of footwear 10. The tread elements 22 extend from the outsole body 20.

[0014] The outsole 16 can be a single-piece or unitary structure and can be manufactured using an insert molding process. The material for the outsole 16 may be selected to provide a desirable combination of durability and flexibility. For instance, the outsole 16 may be wholly or partly made of a thermoplastic or other suitably durable material. As a non-limiting example, the outsole 16 is wholly or partly made of thermoplastic polyurethane (TPU). At least some portions of the outsole 16 may be substantially transparent.

[0015] For purposes of reference, the outsole 16 extends along a longitudinal outsole axis O and has an outsole heel region 26, an outsole midfoot region 28, and an outsole forefoot region 30. The outsole midfoot region 28 is between the outsole heel region 26 and the outsole forefoot region 30. For purposes of discussion, the outsole heel region 26, the outsole midfoot region 28, and the outsole forefoot region 30 are defined as the rearmost third, the middle third, and the foremost third of the outsole 16. The outsole heel region 26 generally includes portions of the outsole 16 corresponding with rear portions of a human foot including the calcaneus bone and of a size corresponding with the outsole 16 and article of footwear 10. The outsole forefoot region 30 gener-
ally includes portions of the outsole 16 corresponding with the toes and the joints connecting the metatarsals with the phalanges of the human foot of the size corresponding with the outsole 16 and article of footwear 10. The outsole midfoot region 25 generally includes portions of the outsole 16 corresponding with an arch area of the human foot of the size corresponding with the outsole and article of footwear 10. Accordingly, the outsole midfoot region 28 is also referred to as the outsole arch region.

[0016] As used herein, a lateral side of a component for the article of footwear 10, such as an outsole lateral side 32 of the outsole 16, is a side that corresponds with the side of the foot of the wearer of the article of footwear 10 that is generally further from the other foot of the wearer (i.e., the side closer to the fifth toe of the wearer). The fifth toe is commonly referred to as the little toe. A medial side of a component for the article of footwear 10, such as an outsole medial side 34 of the outsole 16, is the side that corresponds with an inside area of the foot of the wearer and is generally closer to the other foot of the wearer (i.e., the side closer to the halluc of the foot of the wearer). The halluc is commonly referred to as the big toe. The outsole lateral side 32 and the outsole medial side 34 both extend around the periphery of the outsole 16 from the foremost extent 37 to the rearmost extent 38.

[0017] As discussed above, the outsole 16 includes tread elements 22 protruding from the outsole body 20, some of which may be arranged along the outsole medial side 34 and the outsole lateral side 32. In the depicted embodiment, the tread elements 22 are configured as substantially pyramidal shaped protrusions 24 extending from the outsole body 20. The substantially pyramidal shaped protrusions 24 may have different sizes and can enhance the friction between the sole structure 12 and the ground in order to provide stability to the user of the article of footwear 10. The tread elements 22 are distributed along the outsole midfoot region 28, the outsole heel region 26, and the outsole forefoot region 30. The outsole body 20 defines an inner outsole surface 15 and an outer outsole surface 17 opposite the inner outsole surface 15. The tread elements 22 extend from the outer outsole surface 17. The outer outsole surface 17 may also be referred to as the ground contacting surface because it can contact the ground.

[0018] The outsole 16 additionally defines at least one outsole flex groove 29, such as a recess, for aiding the wearer to flex the article of footwear 10 during use. In the depicted embodiment, the outsole 16 defines two outsole flex grooves 29 and each extends from the outsole lateral side 32 to the outsole medial side 34 of the outsole 16.

[0019] The sole structure 12 further includes traction elements 23 disposed along the outsole 16. Although the drawings show a specific number of traction elements 23 at specific locations in the outsole 16, it is contemplated that the sole structure 12 may include more or fewer traction elements 23 at different locations relative to the outsole 16. For example, even though FIG. 1 shows seven traction elements 23, the sole structure 12 may include more or fewer traction elements 23. In the depicted embodiment, the traction elements 23 can be removably mounted to the outsole 16. At least a portion of each traction element 23 extends beyond the outer outsole surface 17.

[0020] In the depicted embodiment, the traction elements 23 include a base 25 and a plurality of annularly arranged spikes 27 extending from the base 25. The spikes 27 can penetrate the ground and, therefore, can help provide good downward pressing support and traction during certain parts of a golf swing. The traction elements 23 can be mounted to the outsole 16 in any desired manner, including via threads, or other retaining or mounting mechanisms. Two traction elements 23 are removably mounted to the outsole heel region 26. Another two traction elements 23 are removably mounted to the outsole midfoot region 28, and three other traction elements 23 are removably mounted to the outsole forefoot region 30. Some of the traction elements 23 are closer to the outsole lateral side 32 of the outsole 16 than other traction elements 23, and other traction elements 23 are closer to the outsole medial side 34 than other traction elements 23.

[0021] The midsole 18 overlays at least part of the outsole 16. Specifically, in the depicted embodiment, the midsole 18 is directly secured to the outsole 16 and extends over most or all the outsole heel region 36, most or all the outsole midfoot region 28, and most of the outsole forefoot region 30. Like the outsole 16, the midsole 18 includes a midsole heel region 40, a midsole forefoot region 44, and a midsole midfoot region 42 between the midsole heel region 40 and the midsole forefoot region 44. The midsole heel region 40 is disposed over the outsole heel region 36. The midsole midfoot region 42 is disposed over the outsole midfoot region 28. The midsole forefoot region 44 is disposed over the outsole forefoot region 30. Further, the midsole 18 defines an upper midsole surface 19 and a lower midsole surface 21 opposite to the upper midsole surface 19. The upper midsole surface 19 and the lower midsole surface 21 extend along the midsole heel region 40, the midsole forefoot region 44, and the midsole midfoot region 42. The midsole 18 is entirely or partly made of a material that combines a desired level of resiliency and support, such as ethylene vinyl acetate (EVA) foam.

[0022] The sole structure 12 includes a cushioning layer 46 that overlays the outsole 16. The cushioning layer 46 may be part of the midsole 18. In the depicted embodiment, the cushioning layer 46 is directly secured to the midsole 18 and extends over the midsole heel region 40, the midsole midfoot region 42, and the midsole forefoot region 44. The cushioning layer 46 may be a cushioning foam component, such as a lighter weight and less rigid foam than the midsole 18.

[0023] The midsole 18 is at least partly disposed between the outsole 16 and the midsole 18. The outsole 16 and the midsole 18 can be secured to one another by thermofusing during a molding process, by thermoplastic layers that melt to bond the components, by adhesives, or by any other suitable manner. The footwear upper 14 is secured in any suitable manner to the sole structure 12. More specifically, the footwear upper 14 is secured to an inner peripheral surface 50 of the outsole 16 at the outsole forefoot region 30, and to an inner peripheral surface 52 of the midsole 18 at the in the midsole heel region 40. The cushioning layer 46 has a foot-receiving surface 54. The foot-receiving surface 54 of the cushioning layer 46 may include a foot-receiving surface 58 to aid the wearer in flexing the article of footwear 10 during use. Each surface recess 58 is substantially aligned with at least one outsole flex groove 29 to aid the wearer in flexing the article of footwear 10. The surface recesses 58 generally extend from the lateral side of the sole structure 12 to the medial side of the sole structure 12.

[0024] With reference to FIGS. 4 and 5, the sole structure 12 additionally includes a shank 56 secured to the midsole 18. For instance, the shank 56 can be made using an injection molding process, and the shank 56 can then be bonded to the midsole 18 using an insert molding process. In the depicted embodiment, the shank 56 is only secured to a lower midsole
The shank 56 is wholly or partly made of a substantially stiff material, such as a suitable carbon composite. As a non-limiting example, a suitable carbon composite for the shank 56 is an epoxy matrix reinforced by woven glass. Therefore, the shank 56 is wholly or partly made of a glass filled carbon composite. Regardless of the specific material used, the shank 56 is at least partially made of a substantially stiff material. For purposes of the present disclosure, the outsole 16 is wholly or partly made of a first material, the midsole 18 is wholly or partly made of a second material, and the shank 56 is wholly or partly made of a third material. The third material has a higher stiffness than the first and second materials in order to enhance the stability of the article of footwear 10, especially during a golf swing. Because the shank 56 is made of a carbon composite, the carbon composite of the shank 56 has a stiffness that is greater than the stiffness of the first and second materials. In other words, the material of the shank 56 has a stiffness that is greater than the stiffness of the materials of the outsole 16 and the midsole 18. The material of the outsole 16 (i.e., the first material) is substantially transparent so that the shank 56 is visible through the outsole 16.

The enhanced stability around the outsole midfoot region 28 (due to the incorporation of the shank 56) can help a wearer transfer its weight to the ground so as to effectively transfer power from the wearer’s body to a golf club during a golf swing. While the shank 56 also enhances the stability of the sole structure 12 around the outsole forefoot region 30, the flexibility of the outsole forefoot region 30 is unaffected by the shank 56 because the shank 56 does not extend over the outsole forefoot region 30. The shank 56 also prevents, or at least minimizes, torsion between the heel portion and the forefoot portion of the sole structure 12. Furthermore, because the shank 56 is disposed between the midsole 18 and the outsole 16, the presence of the shank 56 does not adversely affect the cushioning provided by the midsole 18 and the cushioning layer 46.

Referring again to FIGS. 1 and 2, the shank 56 has an asymmetrical shape in order to provide greater bending resistance along the medial side than along the lateral side of the sole structure 12 during a golf swing. It is useful to provide greater bending resistance along the medial side than along the lateral side of the sole structure 12 to account for the different forces applied to the sole structure 12 during the backswing and forward swing of a golf swing. Specifically, the shank 56 includes a shank body 60 disposed only over the outsole midfoot region 28. The shank body 60 extends from the outsole lateral side 32 and the outsole medial side 34 of the outsole 16.

The shank 56 further includes a plurality of legs 62 extending from the shank body 60. Each leg 62 is adjacent to one traction element 23 such that the shank 56 can aid the traction elements 23 in inhibiting bending around the outsole midfoot region 28 during a golf swing. For instance, the four traction elements 23 can be disposed immediately adjacent to the legs 62 of the shank 56. The shank 56 may include four legs 62. In particular, the shank 56 includes a first leg 64, a second leg 66, a third leg 68, and a fourth leg 70 each extending from the shank body 60. The first leg 64 and third leg 68 extend from the shank body 60 substantially toward the outsole forefoot region 30, and the second leg 66 and the fourth leg 70 extend from the shank body 60 substantially toward the outsole heel region 26. The first leg 64 and second leg 66 are closer to the outsole lateral side 32 than to the outsole medial side 34. On the other hand, the third leg 68 and the fourth leg 70 are closer to the outsole medial side 34 than to the outsole lateral side 32. As shown in FIG. 5, the cross-section of the legs 62 may have a substantially undulated or concave cross-section in order to enhance the rigidity of the shank 56. In other words, each of the legs 62 may have an undulated or concave cross-section. Accordingly, the cross-section of the legs 62 is not flat.

The shank body 60 has a maximum body width BW. The first leg 64, second leg 66, third leg 68, and fourth leg 70 have a first maximum leg width W1, a second maximum leg width W2, a third maximum leg width W3, and a fourth maximum leg width W4, respectively. The maximum body width BW is greater than the first maximum leg width W1, the second maximum leg width W2, the third maximum leg width W3, and the fourth maximum leg width W4 such that the stiffness of the shank 56 is greater at the shank body 60 than at the legs 62. The first maximum leg width W1, the second maximum leg width W2, the third maximum leg width W3, and the fourth maximum leg width W4 may be different from one another in accordance with the stiffness needs in the lateral side and medial side of the sole structure 12 during a golf swing. For instance, the third maximum leg width W3 is greater than the fourth maximum leg width W4. It is contemplated that the first maximum leg width W1, the second maximum leg width W2, and the fourth maximum leg width W4 may be equal. The first leg 64, second leg 66, third leg 68, and fourth leg 70 have a first minimum leg width M1, a second minimum leg width M2, a third minimum leg width M3, and a fourth minimum leg width M4, respectively. The widths of each of the first leg 64, second leg 66, third leg 68, and fourth leg 70 may vary along their length.

Each leg 62 may be obliquely angled relative to the longitudinal outsole axis O. Specifically, the first leg 64 extends along a first leg axis L1 that is obliquely angled relative to the longitudinal outsole axis O. The first axis L1 intersects the midfoot MA of the first minimum leg width M1 and the midpoint of the maximum leg width W1. The second leg 66 extends along a second leg axis L2 that is obliquely angled relative to the longitudinal outsole axis O. The second leg axis L2 intersects the midfoot MC of the second minimum leg width M2 and the midpoint MD of the second maximum leg width W2. The third leg 68 extends along a third leg axis L3 that is obliquely angled relative to the longitudinal outsole axis O. The third leg axis L3 intersects the midfoot ME of the third minimum leg width M3 and the midpoint MF of the third maximum leg width W3. The fourth leg 70 extends along a fourth leg axis L4 that is obliquely angled relative to the longitudinal outsole axis O. The fourth leg axis L4 intersects the midfoot MH of the fourth minimum leg width M4 and the midpoint MG of the fourth maximum leg width W4. The first leg axis L1, the second leg axis L2, the third leg axis L3, and the fourth leg axis L4 are also obliquely angled relative to one another. In other words, the first leg 64, the second leg 66, the third leg 68, and the fourth leg 70 are obliquely angled relative to the longitudinal outsole axis O and to one another. The orientation of the legs 62 relative to the longitudinal outsole axis O can aid the sole...
structure 12 in providing greater bending resistance along the medial side than along the lateral side of the sole structure 12 during a golf swing.

[0031] The shank 56 defines a curved lateral edge 72 and a medial lateral edge 74. The curved lateral edge 72 has a concave shape so as to substantially match the shape of the outsole lateral side 32. The curved medial edge 74 has a concave shape so as to substantially match the shape of the outsole medial side 34.

[0032] Furthermore, the shank 56 defines a first shank recess 76 between the first leg 64 and third leg 68 and a second shank recess 78 between the second leg 66 and the fourth leg 70. The first shank recess 76 and the second shank recess 78 allow the shank 56 to enhance the stability of the sole structure 12 around the outsole midfoot region 28 without compromising the flexibility of the outsole heel region 26 and the outsole forefoot region 30. Although both are substantially concave, the first shank recess 76 and the second shank recess 78 have different shapes.

[0033] While the best modes for carrying out the present teachings have been described in detail, those familiar with the art to which this disclosure relates will recognize various alternative designs and embodiments for practicing the present teachings within the scope of the appended claims.

1. A sole structure, comprising:
   - an outsole having an outsole forefoot region, an outsole heel region, and an outsole midfoot region between the outsole heel region and the outsole forefoot region, wherein the outsole is at least partially made of a first material;
   - a midsole secured to the outsole, wherein the midsole is at least partially made of a second material; and
   - a shank secured to the midsole and disposed between the midsole and the outsole, wherein the shank has an asymmetrical shape, is at least partially made of a third material, and includes a shank body and a plurality of legs extending from the shank body; and wherein a stiffness of the third material is greater than a stiffness of the first and second materials.

2. The sole structure of claim 1, wherein the third material is a carbon composite.

3. The sole structure of claim 1, wherein the third material is a glass filled carbon composite.

4. The sole structure of any of claim 3, further comprising a plurality of traction elements mounted to the outsole, and wherein each of the plurality of legs is adjacent a respective different one of the plurality of traction elements.

5-17. (canceled)

18. A sole structure, comprising:
   - an outsole extending along a longitudinal outsole axis and having an outsole forefoot region, an outsole heel region, and an outsole midfoot region between the outsole heel region and the outsole forefoot region;
   - a midsole secured to the outsole; and
   - a shank disposed between the midsole and the outsole at the outsole midfoot region, wherein the shank has an asymmetrical shape and includes:
     - a shank body; and
     - a plurality of legs extending from the shank body, wherein at least one of the plurality of legs is obliquely angled relative to the longitudinal outsole axis.

19. The sole structure of claim 19, wherein the plurality of legs includes:
   - a first leg extending from the shank body substantially toward the outsole forefoot region;
   - a second leg extending from the shank body substantially toward the outsole heel region;
   - a third leg extending from the shank body substantially toward the outsole forefoot region; and
   - a fourth leg extending from the shank body substantially toward the outsole heel region.

20. The sole structure of claim 19, wherein the outsole has a lateral side and a medial side, and the first and second legs are closer to the lateral side than to the medial side, and the third and fourth legs are closer to the medial side than to the lateral side of the outsole.

21. The sole structure of any of claim 18, the outsole is at least partially made of a first material, the midsole is at least partially made of a second material, and the shank is at least partially made of a third material, and a stiffness of the third material is greater than a stiffness of the first and second materials.

22. The sole structure of claim 21, wherein the third material is a carbon composite.

23. (canceled)