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GOLF CLUB HEAD FACEPLATES

Abstract

Golf club head faceplates have reinforcement components located on an inner surface of the faceplate to selectively reinforce an outer metallic layer of the faceplate, allowing a reduction of the thickness of the metallic layer, which increases ball speed. The reinforcement layer or component enables the CT to remain at a conforming level and provides sufficient durability.

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Background/Summary

CROSS REFERENCE PRIORITIES [0001] This claims the benefit of U.S. Provisional Application No. 63/551,867, filed Feb. 9, 2024, the contents of which are fully incorporated herein by reference.

TECHNICAL FIELD
[0002] This disclosure relates generally to golf club heads and, more particularly, relates to golf club heads having faceplates with a lightweight reinforcement layer.
BACKGROUND
[0003] Faceplate design must balance the desire for more ball speed with durability concerns and conformance to rules that limit faceplate flex. In general, a thinner faceplate will increase ball speed. A thin faceplate, however, is less durability and more prone to premature failure. Additionally, golf's governing bodies have implements limits on the “characteristic time” (CT) of the faceplate, which is indicative of the spring-like effect of the golf club. Thinner faceplate generally have higher CT response, and therefore CT limits effectively restrict how thin the faceplate can be made. Accordingly, it would be advantageous to provide a faceplate that increase ball speed while mitigation durability concerns and conforming to the CT limits.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0004] To facilitate further description of the embodiments, the following drawings are provided in which:
[0005] FIG. **1** illustrates a front perspective view of a golf club head according to an embodiment.
[0006] FIG. **2** illustrates a front perspective view of the golf club head of FIG. **1** without a faceplate.
[0007] FIG. **3** illustrates a rear elevation view of the faceplate of the golf club head of FIG. **1**.
[0008] FIG. **4** illustrates a rear perspective view of the faceplate of FIG. **3**, in cross-section.
[0009] FIG. **5** illustrates a side elevation view of the faceplate of FIG. **3**, in cross-section.
[0010] FIG. **6** illustrates a detailed perspective view of the faceplate of FIG. **3**, in cross-section.
[0011] FIG. **7** illustrates a detailed perspective view of the faceplate of FIG. **3**, in cross-section.
[0012] FIG. **8** illustrates a rear perspective view of the faceplate of FIG. **3**.
[0013] FIG. **9** illustrates a rear perspective view of the second layer of the faceplate of FIG. **3**, in cross-section.
[0014] FIG. **10**A illustrates a side perspective view of a faceplate according to an embodiment, in cross-section.
[0015] FIG. **10**B illustrates a side perspective view of a faceplate according to an embodiment, in cross-section.
[0016] FIG. **10**C illustrates a side perspective view of a faceplate according to an embodiment, in cross-section.
[0017] FIG. **11** illustrates a rear elevation view of a golf club head according to an embodiment, in cross-section.
[0018] FIG. **12** illustrates a rear elevation view of a golf club head according to an embodiment, in cross-section.
[0019] FIG. **13** illustrates a detailed side elevation view of the golf club head of FIG. **12**, in cross-section.
[0020] FIG. **14** illustrates a detailed side elevation view of the golf club head of FIG. **12**, in cross-section.

[0021] FIG. **15** illustrates a rear perspective view of a golf club head according to an embodiment, in cross-section.
[0022] FIG. **16** illustrates a side perspective view of the golf club head of FIG. **15**, in cross-section.
[0023] FIG. **17** illustrates a rear perspective view of a golf club head according to an embodiment, in cross-section.
[0024] FIG. **18** illustrates top perspective view of the golf club head of FIG. **17**, in cross-section.
[0025] FIG. **19** illustrates a front perspective of a golf club head according to an embodiment without a faceplate and crown insert.
[0026] FIG. **20** illustrates a detailed side perspective view of this golf club head of FIG. **19**, in cross-section.
[0027] FIG. **21** illustrates a rear elevation view of a golf club head according to an embodiment, in cross-section.
[0028] FIG. **22** illustrates a front elevation view of the golf club head of FIG. **21**.
[0029] FIG. **23** illustrates a detailed side elevation view of the golf club head of FIG. **21**, in cross-section.
[0030] FIG. **24** illustrates a rear elevation view of a golf club head according to an embodiment, in cross-section.
[0031] FIG. **25** illustrates a front elevation view of the golf club head of FIG. **24**.
[0032] FIG. **26** illustrates a detailed side elevation view of the golf club head of FIG. **24**, in cross-section.

DEFINITIONS

[0033] Described herein are various embodiments of striking faces, also referred to as faceplates, comprising light weight reinforcement structures provided on an inner surface of the faceplate to increase ball speeds while maintaining conforming CT values by reducing thickness of the outer, metallic, layer of the faceplate.
[0034] For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques may be omitted to avoid unnecessarily obscuring the invention. Additionally, elements in the drawing figures are not necessarily drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help improve understanding of embodiments of the present invention. The same reference numerals in different figures denote the same elements.
[0035] The terms “first,” “second,” “third,” “fourth,” and the like in the description and in the claims, if any, are used for distinguishing between similar elements and not necessarily for describing a particular sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments described herein are, for example, capable of operation in sequences other than those illustrated or otherwise described herein. Furthermore, the terms “include,” and “have,” and any variations thereof, are intended to cover a non-exclusive inclusion, such that a process, method, system, article, device, or apparatus that comprises a list of elements is not necessarily limited to those elements but may include other elements not expressly listed or inherent to such process, method, system, article, device, or apparatus.
[0036] The terms “left,” “right,” “front,” “back,” “top,” “bottom,” “over,” “under,” and the like in the description and in the claims, if any, are used for descriptive purposes and not necessarily for describing permanent relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments of the invention described herein are, for example, capable of operation in other orientations than those illustrated or otherwise described herein.
[0037] The terms “couple,” “coupled,” “couples,” “coupling,” and the like should be broadly understood and refer to connecting two or more elements or signals, electrically, mechanically and/or otherwise.

[0038] The term "characteristic time" (hereafter "CT") is used herein to mean a measurement used to determine the amount of time, measured in microseconds (μs), that a golf ball contacts the club face at the moment of impact. The characteristic time is measured by impacting a specific spot on the striking surface several times using a small steel pendulum. The characteristic time measurement is for wood-type club heads such as drivers, fairway woods, or hybrids. A computer program measures the amount of time the steel pendulum contacts the club face at the moment of impact. CT values were based on the method outlined in the USGA's Procedure for Measuring the Flexibility of a Golf Clubhead. For example, Section 2 of the USGA's Procedure for Measuring the Flexibility of a Golf Clubhead (USGA-TPX3004, Rev. 2.0, Apr. 9, 2019) (the "Protocol For Measuring The Flexibility of A Golf Club Head").

[0039] The term "coefficient of restitution" or "COR" is used herein to mean a measurement used to determine the energy transferred from the club head to the golf ball at impact. The inbound and outbound velocity of a calibrated golf ball being propelled at a clubhead are recorded. These velocities and the mass of the clubhead and the ball are utilized to calculate the COR of a clubhead. COR values were based on the method outlined in the USGA's Procedure for Measuring the Coefficient of Restitution of a Golf Clubhead. For example, Section 2 of the USGA's Procedure for Measuring the Coefficient of Restitution of a Golf Clubhead (USGA-TPX3009, Rev. 2.0, Apr. 9, 2019) (the "Protocol for Measuring the Coefficient of Restitution of a Clubhead Relative to a Baseline Plate").

[0040] The term "strike face," as used herein, refers to a club head front surface that is configured to strike a golf ball. The term strike face can be used interchangeably with the term "face."

[0041] The term "strike face perimeter," as used herein, can refer to an edge of the strike face. The strike face perimeter can be located along an outer edge of the strike face where the curvature deviates from a bulge and/or roll of the strike face.

[0042] The term "geometric centerpoint," or "geometric center" of the strike face, as used herein, can refer to a geometric centerpoint of the strike face perimeter, and at a midpoint of the face height of the strike face. In the same or other examples, the geometric centerpoint also can be centered with respect to an engineered impact zone, which can be defined by a region of grooves on the strike face. As another approach, the geometric centerpoint of the strike face can be located in accordance with the definition of a golf governing body such as the United States Golf Association (USGA).

[0043] The term "ground plane," as used herein, can refer to a reference plane associated with the surface on which a golf ball is placed. The ground plane can be a horizontal plane tangent to the sole at an address position.

[0044] The term "loft plane," as used herein, can refer to a reference plane that is tangent to the geometric centerpoint of the strike face.

[0045] The term "loft angle," as used herein, can refer to an angle measured between the loft plane and the XY plane (defined below).

[0046] The term "face height," as used herein, can refer to a distance measured parallel to loft plane between a top end of the strikeface perimeter and a bottom end of the strikeface perimeter.

[0047] The term "lie angle," as used herein, can refer to an angle between a hosel axis, extending through the hosel, and the ground plane. The lie angle is measured from a front view.

[0048] The "depth" of the golf club head, as described herein, can be defined as a front-to-rear dimension of the golf club head.

[0049] The "height" of the golf club head, as described herein, can be defined as a crown-to-sole dimension of the golf club head. In many embodiments, the height of the club head can be measured according to a golf governing body such as the United States Golf Association (USGA).

[0050] The "length" of the golf club head, as described herein, can be defined as a heel-to-toe dimension of the golf club head. In many embodiments, the length of the club head can be measured according to a golf governing body such as the United States Golf Association (USGA).

[0051] The “face height” of the golf club head, as described herein, can be defined as a height measured parallel to loft plane between a top end of the strike face perimeter near the crown and a bottom end of the strike face perimeter near the sole.
[0052] The “geometric center height” of the fairway-type golf club head, as described herein, is a height measured perpendicular from the ground plane to the geometric centerpoint of the golf club head.
[0053] The “leading edge” of the club head, as described herein, can be identified as the most sole-ward portion of the strike face perimeter.
[0054] A “thickness”, as described herein is the length of a line segment connecting two points on opposing surfaces oriented perpendicular to one of the points.
[0055] An “XYZ” coordinate system of the golf club head, as described herein, is based upon the geometric center of the strike face. The golf club head dimensions as described herein can be measured based on a coordinate system as defined below. The geometric center of the strike face defines a coordinate system having an origin located at the geometric center of the strike face. The coordinate system defines an X axis, a Y axis, and a Z axis. The X axis extends through the geometric center of the strike face in a direction from the heel to the toe of the fairway-type club head. The Y axis extends through the geometric center of the strike face in a direction from the crown to the sole of golf club head. The Y axis is perpendicular to the X axis. The Z axis extends through the geometric center of the strike face in a direction from the front end to the rear end of the golf club head. The Z axis is perpendicular to both the X axis and the Y axis.
[0056] The term or phrase “center of gravity position” or “CG location” can refer to the location of the club head center of gravity (CG) with respect to the XYZ coordinate system, wherein the CG position is characterized by locations along the X-axis, the Y-axis, and the Z-axis. The term “CGx” can refer to the CG location along the X-axis, measured from the origin point. The term “CG height” can refer to the CG location along the Y-axis, measured from the origin point. The term “CGy” can be synonymous with the CG height. The term “CG depth” can refer to the CG location along the Z-axis, measured from the origin point. The term “CGz” can be synonymous with the CG depth.
[0057] The term or phrase “CG projection” or “CG projection point” can refer to the location where the CG is projected on the strike face, wherein the projection is taken normal to the loft plane.
[0058] The XYZ coordinate system of the golf club head, as described herein defines an XY plane extending through the X axis and the Y axis. The coordinate system defines XZ plane extending through the X axis and the Z axis. The coordinate system further defines a YZ plane extending through the Y axis and the Z axis. The XY plane, the XZ plane, and the YZ plane are all perpendicular to one another and intersect at the coordinate system origin located at the geometric center of the strike face. In these or other embodiments, the golf club head can be viewed from a front view when the strike face is viewed from a direction perpendicular to the XY plane. Further, in these or other embodiments, the golf club head can be viewed from a side view or side cross-sectional view when the heel is viewed from a direction perpendicular to the YZ plane.
[0059] The golf club head further comprises a coordinate system centered about the center of gravity. The coordinate system comprises an X′-axis, a Y′-axis, and a Z′-axis. The X′-axis extends in a heel-to-toe direction. The X′-axis is positive towards the heel and negative towards the toe. The Y′-axis extends in a sole-to-crown direction and is orthogonal to both the Z′-axis and the X′-axis. The Y′-axis is positive towards the crown and negative towards the sole. The Z-axis extends front-to-rear, parallel to the ground plane and is orthogonal to both the X′-axis and the Y′-axis. The Z′-axis is positive towards the strike face and negative towards the rear.
[0060] The term or phrase “moment of inertia” (hereafter “MOI”) can refer to a value derived using the center of gravity (CG) location. The MOI can be calculated assuming the club head includes the body and the hosel structure. The term “MOI.sub.xx” or “I.sub.xx” can refer to the MOI measured

about the X′-axis. The term "MOI.sub.yy" or "I.sub.yy" can refer to the MOI measured about the Y′-axis. The term "MOI.sub.zz" or "I.sub.zz" can refer to the MOI measured about the Z′-axis. The MOI values MOI.sub.xx, MOI.sub.yy, and MOI.sub.zz determine how forgiving the club head is for off-center impacts with a golf ball.

[0061] A "driver-type golf club head," also referred to as a driver, as described herein, can be defined by specific dimensional ranges. In particular, the driver, as described with regard to the invention disclosed herein, includes a loft angle, volume, length, depth, and height within the ranges defined below.

[0062] The "loft angle" of the driver can be less than approximately 16 degrees, less than approximately 15 degrees, less than approximately 14 degrees, less than approximately 13 degrees, less than approximately 12 degrees, less than approximately 11 degrees, or less than approximately 10 degrees.

[0063] The volume of the driver can be greater than approximately 300 cm.sup.3, greater than approximately 350 cm.sup.3, greater than approximately 400 cm.sup.3, greater than approximately 425 cm.sup.3, greater than approximately 450 cm.sup.3, greater than approximately 475 cm.sup.3, greater than approximately 500 cm.sup.3, greater than approximately 525 cm.sup.3, greater than approximately 550 cm.sup.3, greater than approximately 575 cm.sup.3, greater than approximately 600 cm.sup.3, greater than approximately 625 cm.sup.3, greater than approximately 650 cm.sup.3, greater than approximately 675 cm.sup.3, or greater than approximately 700 cm.sup.3.

[0064] The height of the driver can be greater than 2.0 inches and less than 3.0 inches, less than 2.9 inches, less than 2.8 inches, less than 2.7, or less than 2.6 inches.

[0065] The face height of the driver can be between 1.3 inches (33 mm) and 3.8 inches (71 mm).

[0066] The driver can comprise a mass between 185 grams and 225 grams. The mass of the driver can range between 185 grams and 190 grams, between 190 grams and 195 grams, between 195 grams and 200 grams, between 200 grams and 205 grams, between 205 grams and 210 grams, between 210 grams and 215 grams, between 215 grams and 220 grams, or between 220 grams and 225 grams.

[0067] A "fairway-type golf club head" as defined herein is a club head having particular lofts, volumes, and dimensions that can be defined by specific dimensional ranges. In particular, the fairway-type club head, as described with regard to the invention disclosed herein, includes a loft angle, volume, length, depth, height, and face height within the ranges defined below. The specified ranges below limit the fairway-type golf club head to a fairway-type club head. In other words, the fairway-type golf club head cannot be a driver type, a hybrid-type, an iron-type, or a putter-type golf club head.

[0068] The "loft angle" of the fairway-type club head as defined herein can be less than approximately 35 degrees, less than approximately 34 degrees, less than approximately 33 degrees, less than approximately 32 degrees, less than approximately 31 degrees, or less than approximately 30 degrees. In some embodiments, the loft angle of the fairway-type golf club head can be greater than approximately 12 degrees, greater than approximately 13 degrees, greater than approximately 14 degrees, greater than approximately 15 degrees, greater than approximately 16 degrees, greater than approximately 17 degrees, greater than approximately 18 degrees, greater than approximately 19 degrees, or greater than approximately 20 degrees. For example, in some embodiments, the loft angle of the fairway-type golf club head can be between 14 degrees and 35 degrees, between 15 degrees and 35 degrees, between 20 degrees and 35 degrees, or between 12 degrees and 30 degrees.

[0069] The "volume" of the fairway-type club as described herein can be less than approximately 170 cm.sup.3, less than approximately 180 cm.sup.3, less than approximately 190 cm.sup.3, or less than approximately 200 cm.sup.3. However, the volume of the fairway-type club cannot be less than 160 cm.sup.3. In some embodiments, the volume of the fairway-type club head can be between approximately 150 cm.sup.3 to 200 cm.sup.3, between approximately 160 cm.sup.3 to 170 cm.sup.3, between approximately 160 cm.sup.3 to 180 cm.sup.3, or between approximately 170 cm.sup.3 to 190 cm.sup.3. The volume of the fairway-type club cannot be greater than 200 cm.sup.3. In one exemplary embodiment, the volume of the fairway-type club is 169 cm.sup.3.

[0070] The “depth” of the fairway-type golf club can be in a range of between 3.00 inches to 4.00 inches. In some embodiments, the depth can be between 3.00 inches to 3.40 inches, between 3.25 inches to 3.40 inches, between 3.30 inches to 3.50 inches, or between 3.50 inches to 4.00 inches. The depth cannot be greater than 4.00 inches.

[0071] The “height” of the fairway-type golf club head can be in a range of between 1.25 inches to 2.00 inches. In some embodiments, the height can be between 1.25 inches to 1.50 inches, between 1.30 inches to 1.50 inches, between 1.35 inches to 1.75 inches, between 1.45 inches to 1.80 inches, or between 1.50 inches to 2.00 inches. In one exemplary embodiment, the height is 1.424 inches. The height is not greater than 2.00 inches.

[0072] The “length” of the fairway-type golf club head can be in a range of between 3.00 inches to 4.60 inches. In some embodiments, the length can be between 3.00 inches to 4.00 inches to 4.40 inches, between 4.25 inches to 4.40 inches, or between 4.30 inches to 4.60 inches. The length is not greater than 4.60 inches.

[0073] The “face height” of the fairway-type golf club head can range from 1.00 inches to 1.50 inches. In some embodiments, the face height can be between 1.00 inches to 1.25 inches, between 1.00 inches to 1.15 inches, between 1.15 inches to 1.35 inches, or between 1.15 inches to 1.50 inches.

[0074] The “geometric center height” of the fairway-type golf club head can range from 0.40 inch to 0.75 inch. For example, the geometric center height can be between 0.40 inch to 0.60 inch, between 0.50 inch to 0.70 inch, or between 0.65 inch to 0.75 inch.

[0075] The term “iron,” as used herein, can, in some embodiments, refer to an iron-type golf club head having a loft angle that is less than approximately 50 degrees, less than approximately 49 degrees, less than approximately 48 degrees, less than approximately 47 degrees, less than approximately 46 degrees, less than approximately 45 degrees, less than approximately 44 degrees, less than approximately 43 degrees, less than approximately 42 degrees, less than approximately 41 degrees, or less than approximately 40 degrees. Further, in many embodiments, the loft angle of the club head is greater than approximately 16 degrees, greater than approximately 17 degrees, greater than approximately 18 degrees, greater than approximately 19 degrees, greater than approximately 20 degrees, greater than approximately 21 degrees, greater than approximately 22 degrees, greater than approximately 23 degrees, greater than approximately 24 degrees, or greater than approximately 25 degrees.

[0076] In many embodiments, such as for “game improvement irons”, the volume of the club head is less than approximately 65 cm.sup.3, less than approximately 60 cm.sup.3, less than approximately 55 cm.sup.3, or less than approximately 50 cm.sup.3. In some embodiments, the volume of the club head can be approximately 50 cm.sup.3 to 60 cm.sup.3, approximately 51 cm.sup.3-53 cm.sup.3, approximately 53 cm.sup.3-55 cm.sup.3, approximately 55 cm.sup.3-57 cm.sup.3, or approximately 57 cm.sup.3-59 cm.sup.3.

[0077] In many embodiments, such as for “player's irons”, the volume of the club head is less than approximately 45 cm.sup.3, less than approximately 40 cm.sup.3, less than approximately 35 cm.sup.3, or less than approximately 30 cm.sup.3. In some embodiments, the volume of the club head can be approximately 31 cm.sup.3-38 cm.sup.3 (1.9 cubic inches to 2.3 cubic inches), approximately 31 cm.sup.3-33 cm.sup.3, approximately 33 cm.sup.3-35 cm.sup.3, approximately 35 cm.sup.3-37 cm.sup.3, or approximately 37 cm.sup.3-39 cm.sup.3.

[0078] In some embodiments, the iron can comprise a total mass ranging between 180 grams and 260 grams, 190 grams and 240 grams, 200 grams and 230 grams, 210 grams and 220 grams, or 215 grams and 220 grams. In some embodiments, the total mass of the club head is 215 grams, 216 grams, 217 grams, 218 grams, 219 grams, or 220 grams.

DESCRIPTION

[0079] Described herein are various embodiments of faceplates, to be used in golf club heads, having a lightweight reinforcement layer, alone or in combination with other arrangements, to improve ball speeds while maintaining a conforming CT value. The lightweight reinforcement layer (also referred to as the second layer) strategically reinforces the metallic layer (also referred to as the first layer) so that the metallic layer thickness may be reduced. The lightweight reinforcement layer increases the durability of the thin metallic layer and regulates the CT value of the faceplate, thereby creating a multi-material faceplate with higher ball speeds for the same, conforming, CT value.
[0080] In many embodiments, the metallic layer may comprise complementary receiving geometry that creates an improved interface between the metallic layer and reinforcement layer while also reducing the thickness of the metallic layer to increase ball speeds while maintaining durability and CT values. The receiving geometry can be referred to as a pocket, recess, indentation, dent, depression, cutout, groove, or other structure which has an area of decreased thickness relative to the surrounding region. In other embodiments, the second layer can have a circular or oval shape that surrounds a recess formed in the first layer.
[0081] In other embodiments, the two-layer faceplate can comprise additional reinforcing structures such as struts, bars, beams, or ribs that contact a rear surface of the faceplate to provide additional reinforcement means to regulate ball speed, CT values, and/or durability. The reinforcing structures can attach and extend to portions of the body adjacent to the faceplate. In some embodiments, the reinforcing structures are coupled to the body via receivers. In other embodiments, the reinforcing structures and receivers can be integrally formed with the body.
[0082] The faceplates described herein are configured to couple to a golf club head body to form at least a portion of a striking surface, and are configured to increase ball speed while maintaining a conforming CT value and durability. In some embodiments, the golf club head **100** comprises a body **101** having a front opening **106** and a faceplate **108** coupled to the body **101** and configured to extend over the front opening **106**, as best shown in FIGS. **1** and **2**. The body **101** further comprises a crown **102**, a sole **103**, a heel **104**, and a toe **105**. The front opening is contained entirely on the front of the body such that no portion of the faceplate extends onto the crown, sole, heel, or toe. In other embodiments, the faceplate may extend onto the crown, sole, and/or skirt of the club head body.
[0083] In many embodiments, the faceplate described herein has a two-layer construction such that the faceplate comprises first layer and a second layer, wherein the second layer reinforces and supports the first layer. In most embodiments, the first layer is formed of a metallic material and forms an exterior surface of the club head. In most embodiments, the second layer is coupled to a rear, or inner, surface of the first layer. As such, the second layer is exposed to the internal cavity and is not visible from an exterior view of the club head. In other embodiments, the second layer can be coupled to the interior surface of the body adjacent to the faceplate such that the second layer does not contact the first layer. In further embodiments, the second layer may be positioned at various other positions on or around the striking surface to reinforce or support selected regions of the club head body and/or the faceplate.
[0084] The first layer forms an outer or exterior portion of the faceplate and a portion of the striking surface so that the impacting surface is formed from a durable, high yield metallic material to that can withstand golf ball impacts and provide friction needed to control spin and launch angle. In some embodiments, the metallic layer further facilitates coupling of the faceplate to the body so that the metallic faceplate may be welded to the body to cover the front opening. As such, the metallic first layer increases ball speed and improves spin and launch angle.
[0085] In some embodiments, the first layer is formed of material selected from one or more of the following metallic materials: titanium (Ti), titanium alloy (e.g. Ti-6-4, Ti-8-1-1, T-9S, or BE α-β Ti alloy), aluminum (Al), aluminum alloy, steel, steel alloy, tin, tin alloy, or any other suitable metallic material. In one example, the first layer is formed of titanium alloy Ti-6-4 and the club head body is

formed of titanium alloy Ti-8-1-1.

[0086] The first layer can have a first layer thickness that can be selected to either increase or decrease ball speed. In some embodiments, the first layer has a variable thickness, in which some region have greater thickness while other regions have less thickness. In other embodiments, the thickness of the first layer can be constant. In some embodiments, the thickness of the first layer can be between 0.0025 and 0.0925 inch. In some examples, the first layer can be between 0.0025 and 0.0075, 0.0075 and 0.0125, 0.0125 and 0.0175, 0.0175 and 0.0225, 0.0225 and 0.0275, 0.0275 and 0.0325, 0.0325 and 0.0375, 0.0375 and 0.0425, 0.0425 and 0.0475, 0.0475 and 0.0525, 0.0525 and 0.0575, 0.0575 and 0.0625, 0.0625 and 0.0675, 0.0675 and 0.0725, 0.0725 and 0.0775 inch, 0.0775 and 0.0825, 0.0825 and 0.0875, or 0.0875 and 0.0925 inch.

[0087] In some embodiments, the thickness of the first layer can be up to 0.0025, 0.0075, 0.0125, 0.0175, 0.0225, 0.0275, 0.0325, 0.0375, 0.0425, 0.0475, 0.0525, 0.0575, 0.0625, 0.0675, 0.0725, 0.0775, 0.0825, 0.0875, or 0.0925 inch. In some embodiments, the thickness of the first layer can be at least 0.0025, 0.0075, 0.0125, 0.0175, 0.0225, 0.0275, 0.0325, 0.0375, 0.0425, 0.0475, 0.0525, 0.0575, 0.0625, 0.0675, 0.0725, 0.0775, 0.0825, 0.0875, or 0.0925 inch. In some embodiments, the thickness of the first layer can be greater than or equal to 0.0025, 0.0075, 0.0125, 0.0175, 0.0225, 0.0275, 0.0325, 0.0375, 0.0425, 0.0475, 0.0525, 0.0575, 0.0625, 0.0675, 0.0725, 0.0775, 0.0825, 0.0875, or 0.0925 inch. In some embodiments, the thickness of the first layer can be less than or equal to 0.0025, 0.0075, 0.0125, 0.0175, 0.0225, 0.0275, 0.0325, 0.0375, 0.0425, 0.0475, 0.0525, 0.0575, 0.0625, 0.0675, 0.0725, 0.0775, 0.0825, 0.0875, or 0.0925 inch. For example, the thickness of the first layer can 0.0025, 0.0075, 0.0125, 0.0175, 0.0225, 0.0275, 0.0325, 0.0375, 0.0425, 0.0475, 0.0525, 0.0575, 0.0625, 0.0675, 0.0725, 0.0775, 0.0825, 0.0875, or 0.0925 inch. In other examples, the thickness of the first layer can be 0.005, 0.010, 0.015, 0.020, 0.025, 0.030, 0.035, 0.040, 0.045, 0.050, 0.055, 0.060, 0.065, 0.070, 0.075, 0.080, 0.085, or 0.090 inch.

[0088] The second layer is made from a light-weight material, such as composite, that is coupled directly to, or adjacent, the first layer to provide sufficient durability and conforming CT values. The second layer can comprise a plurality of uni-directional, multi-directional, or a combination of uni- and multi-directional fibers that are aligned and layered with various orientations. The composition and orientation of the composite fibers affect strength and weight ratio properties of the MC panel, which allow the MC panel to withstand the high stresses and impact forces typical of a golf club head. The material used for the second layer can be less dense, lighter weight, and/or more flexible than the materials used for the first layer. Thus, the second layer can be used to reduce the volume of heavy metallic material used in the club, thereby reducing weight, while maintaining strength, durability, and CT values.

[0089] In some embodiments, the material used for the second layer includes a polymer matrix that receives the fibers to adjust the overall weight and strength of the second layer. The polymer matrix can be any one or a combination of the following materials: polyethylenimine (PEI), polyphthalamide (PPA), polyphenylene (PPS), polyether ether ketone (PEEK), polyaryletherketone (PAEK), thermoplastic polyurethane (TPU), Nylon 6 (6-6, 11, 12), polyimide (PI), polyamide-imide (PAI), polyetherketone (PEK), polyphenylesulfone (PPSU), polyethersulfone (PSU), polyvinylidene fluoride (PVDF), polytetrafluoroethylene (PTFE), perfluoroalkoxy alkanes (PFA), polyamide 46 (P46), polyamide 66 (PA66), polyamide 12 (PA12), polyamide 11 (PA11), polyamide 6 (PA6), polyamide 6.6 (PA6.6), polyamide 6.6/6 (PA6.6/6), amorphous polyamide (PA6-3-T), polyethylene terephthalate (PET), liquid crystal polymer (LCP), polycarbonate (PC), polybutylene terephthalate (PBT), polyoxymethylene (POM), polyphenyl ether (PPE), polymethylmethacrylate (PMMA), polypropylene (PP), polymethylene (PE), high density polyethylene (HDPE), acrylonitrile styrene acrylate (ASA), styrene acrylonitrile (SAN), acrylonitrile butadiene styrene (ABS), polybenzimidazole (PBI), polyvinyl chloride (PVC), poly-para-phenylene-copolymer (PPP), polyacrylonitrile, polyethylenimine, polyetherketonetherketoneketone (PEKEKK), ethylene tetrafluoroethylene (ETFE), polychlorotrifluoroethylene (PCTFE), or polymethylpentene (PMP).

[0090] The fibers used in the material forming the second layer can include any one or combination of the following materials: polymer, synthetic, and natural fibers. In some embodiments, the fibers can be carbon fiber, glass fiber, Kevlar fiber, ultra-high molecular weight polyethylene (UHMWPE) fiber, basalt fiber, silicon fiber, carbide fiber, aramid fiber, zirconia fiber, boron fiber, alumina fiber, silica fiber, borosilicate fiber, mullite fiber, cotton fiber, or any other suitable natural or synthetic fiber. In one example, the material used to form the second layer is a thermoplastic polymer matrix reinforced with carbon fiber.

[0091] A composition of the composite material used for the second layer can vary with different volumes of fiber material between polymer fibers and other suitable fibers as identified above. In some embodiments, the volume of the composite may be made of at least 30%, at least 40%, at least 50%, at least 60%, at least 70%, at least 80%, at least 90%, at least 95%, at least 97%, or at least 99% of a polymer material, while the remaining percent volume is of a suitable natural or synthetic fiber material. In other examples, the volume of polymer present in the composite can be between 30% and 35%, 35% and 40%, 40% and 45%, 45% and 50%, 50% and 55%, 55% and 60%, 60% and 65%, 65% and 70%, 70% and 75%, 75% and 80%, 80% and 85%, 85% and 90%, 90% and 95%, or 95% and 100%.

[0092] The second layer's fibers can be unidirectional, multidirectional, or a combination of both unidirectional and multidirectional. In some embodiments, multiple sets of unidirectional fibers can be oriented in a combination of more than one direction.

[0093] The content, structure, and construction of the first layer and the second layer may be any of those described in U.S. Pat. No. 911,669, titled ‘Golf Club Head with Multi-Material Construction’, filed on Jun. 30, 2022, the contents of which are incorporated herein by reference.

[0094] Combining the first layer and the second layer forms a faceplate to be used in a golf club head body to increase ball speed over conventional single material, metallic faceplates. In many embodiments, the faceplate is used in a driver-type club head comprising a crown, a sole, a heel end, a toe end, a rear, and a front end having a front opening. The faceplate is coupled to the front opening to complete the club head construction. In other embodiments, the faceplate construction can be used in other club head types such as fairway woods, hybrids, irons, wedges, or putters, to achieve similar effects of the golf club heads of the present invention.

[0095] In one exemplary embodiment of the present invention, a golf club head **100** comprises a faceplate **108**, having a first layer and a second layer, that increases ball speed while maintaining a conforming CT value and durability. Specifically, the golf club head **100** comprises a body **101** having a front opening **106** and a faceplate **108** coupled to the body **101** and configured to extend over the front opening **106**, as best shown in FIGS. **1** and **2**. The faceplate **108** further comprises a first layer **110** composed of a metallic material having a first layer front surface **112**, a first layer rear surface **114**, and a recess formed on the first layer rear surface **114** extending towards the first layer front surface **112** and bounded by a recess bottom surface **116** and a recess side wall **118**. The faceplate **108** further comprises a second layer **120** composed of a fiber-reinforced composite layer and having a second layer rear surface **124** and a second layer front surface **122** abutting the first layer rear surface **114**, as best shown in FIGS. **3-9**. The faceplate **108** comprising the recess and a lightweight reinforcing layer coupled to the recess increases ball speed while maintaining CT and durability. The recess on the first layer rear surface enables thinning of the metal to increase face flexure and also facilitates coupling of the second layer to the first layer. The second layer reinforces and supports the first layer to regulate the CT values and durability resulting in a net increase of ball speed for the same CT value.

[0096] The first layer **110** comprises a recess depth **117** that can be adjusted to alter the thickness of the first layer thereby adjusting the face flexure. The recess depth **117** is measured as the distance between the first layer rear surface **114** and the recess bottom surface **116**, along the recess side wall **118**, as best shown in FIG. **7**. As the recess depth **117** increases, the face flexure and ball speed increases, at the sacrifice of durability and higher CT values. The recess depth **117** can range from

0.005 to 0.080 inch. For example, in some embodiments, the recess depth **117** can range from 0.005 to 0.010 inch, 0.010 to 0.015 inch, 0.015 to 0.025 inch, 0.025 to 0.035 inch, 0.035 to 0.045 inch, 0.045 to 0.055 inch, 0.055 to 0.065 inch, 0.065 to 0.075 inch, or from 0.075 to 0.080 inch.

[0097] The recess depth **117** can also be considered as the thickness of metal material removed from the first layer rear surface **114**. In some embodiments, the recess depth **117** is uniform across the entire first layer rear surface **114** such that a uniform thickness of material was removed from the first layer rear surface **114**. In other embodiments, the recess depth **117** can comprise a variable depth such that the recess is deeper in some portions while being shallower in others. For example, the recess can be deeper around the perimeter of the recess while being shallower in the center. Conversely, in some embodiments, the recess can be deeper in the central portion while being shallower in the perimeter portions. The recess can be either uniform or variable to provide a desired first layer thickness profile.

[0098] The first layer **110** comprises an offset distance **119** that can be adjusted to provide sufficient spacing for the faceplate **108** to be welded to the body. The offset distance **119** is the distance between a perimeter wall **115** and the recess side wall **118**, as best shown in FIG. **6**. The offset distance **119** enables welding of the faceplate **108** to the body **101** without destroying or damaging the second layer **120** from the high heat of the welding process. The offset distance **119** can range from 0.05 inch to 0.50 inch. For example, in some embodiments, the offset distance **119** can range from 0.05 to 0.10 inch, 0.10 to 0.15 inch, 0.15 to 0.20 inch, 0.20 to 0.25 inch, 0.25 to 0.30 inch, 0.30 to 0.35 inch, 0.35 to 0.40 inch, 0.40 to 0.45 inch, or from 0.45 to 0.50 inch. The offset distance **119** can be anywhere from 0.020 inch to 0.075 inch larger than the width of the weld beam to provide sufficient spacing for the weld line.

[0099] The first layer **110** comprises a recess thickness which is the thickness of the first layer at the recess and can be adjusted to alter flexure and ball speed of the faceplate **108**. The recess thickness is measured from the recess bottom surface **116** to the first layer front surface **112**. The recess thickness can range from 0.020 to 0.150 inch. For example, in some embodiments, the recess thickness can range from 0.020 to 0.030 inch, 0.030 to 0.040 inch, 0.040 to 0.050 inch, 0.050 to 0.060 inch, 0.060 to 0.070 inch, 0.070 to 0.080 inch, 0.080 to 0.090 inch, 0.090 to 0.100 inch, 0.100 to 0.110 inch, 0.110 to 0.120 inch, 0.120 to 0.130 inch, 0.130 to 0.140 inch, or 0.140 to 0.150 inch.

[0100] The recess thickness can vary across the recess bottom surface **116**. For example, in some embodiments, the recess thickness is greatest at geometric center of the faceplate and the recess thickness is the least at the perimeter portions along the recess side wall **118**. Specifically, the first layer **110** comprises a first thickness measured at the geometric center as the distance between the first layer front surface **112** and the first layer rear surface **114** and a second thickness measured at a perimeter of the recess bottom surface **116**. The first thickness can have a greater thickness than the second thickness. The first thickness can comprise the max thickness while the second thickness can comprise the minimum thickness of the entire first layer **110**. In other embodiments, the recess thickness is uniform across the recess bottom surface **116** such that the first thickness is equal to the second thickness.

[0101] The first layer further comprises a perimeter thickness selected to maintain sufficient durability at perimeter regions of the faceplate **108**. Due to the perimeter location of the perimeter thickness, the thickness of the faceplate at this region has a greater affect on durability and less of an effect on ball speed. The perimeter thickness is measured as the distance between the first layer rear surface **114** and the first layer front surface **112**. In some embodiments, the perimeter thickness is greater than the recess thickness. In other embodiments, the perimeter thickness can be equal to or less than the recess thickness, depending on thickness requirements of the faceplate. The perimeter thickness can range from 0.025 inch to 0.250 inch. In other embodiments, the perimeter thickness can be between 0.025 inch and 0.035 inch, 0.035 inch and 0.045 inch, 0.045 inch and 0.055 inch, 0.055 inch and 0.065 inch, 0.065 inch and 0.075 inch, 0.075 inch and 0.085 inch, 0.085

inch and 0.095 inch, 0.095 inch and 0.105 inch, 0.105 inch and 0.115 inch, 0.115 inch and 0.125 inch, 0.125 inch and 0.135 inch, 0.135 inch and 0.145 inch, 0.145 inch and 0.155 inch, 0.155 inch and 0.165 inch, 0.165 inch and 0.175 inch, 0.175 inch and 0.185 inch, 0.185 inch and 0.195 inch, 0.195 inch and 0.205 inch, 0.205 inch and 0.215 inch, 0.215 inch and 0.225 inch, 0.225 inch and 0.235 inch, 0.235 inch and 0.245 inch, or 0.245 inch and 0.250 inch

[0102] The overall shape of the recess and the recess bottom surface **116** and/or the recess side wall **118**, can be selected to provide an increase in face flexure at desired regions of the faceplate. In some embodiments, the recess bottom surface **116** and/or recess side wall **118** can be aligned, continuous, or parallel to the perimeter wall **115** such that the recess bottom surface **116** and/or recess side wall **118** has a similar profile as the perimeter wall **115**. In other embodiments, the profile of the recess bottom surface **116** and/or recess side wall **118** can be different than the perimeter wall **115**. For example, in some embodiments, the recess bottom surface **116** and/or recess side wall **118** can have a profile that is circular, rectangular, oval, triangular, or any other geometric shape to provide a desired flexibility of the faceplate.

[0103] The recess bottom surface **116** comprises a surface area that can be selected to alter the flexure response and to regulate ball speed across the faceplate **108**. The surface area of the recess bottom surface **116** can range from 1.0 in.sup.2 to 4.0 in.sup.2. In other embodiments, the surface area of the recess bottom surface may be between 1.0 in.sup.2 to 1.3 in.sup.2, 1.3 in.sup.2 to 1.6 in.sup.2, 1.6 in.sup.2 to 1.9 in.sup.2, 1.9 in.sup.2 to 2.2 in.sup.2, 2.2 in.sup.2 to 2.5 in.sup.2, 2.5 in.sup.2 to 2.8 in.sup.2, 2.8 in.sup.2 to 3.1 in.sup.2, 3.1 in.sup.2 to 3.4 in.sup.2, 3.4 in.sup.2 to 3.7 in.sup.2, or 3.7 in.sup.2 to 4.0 in.sup.2.

[0104] In some embodiments, the first layer **110** can comprise a variable thickness profile to normalize flexure response across the first layer front surface **112**. As such, the first layer front surface **112** can comprise a curvature such as a bulge and roll curvature for wood-type club heads. The first layer rear surface **114** and/or the recess bottom surface **116** can be non-planar such that the first layer rear surface **114** and/or the recess bottom surface **116** comprises a variable thickness profile. In other embodiments, the first layer **110** may comprise substantially uniform thickness such that the first layer rear surface **114** and/or the recess bottom surface **116** is substantially planar.

[0105] In many embodiments, the recess bottom surface **116** can comprise bonding features **113** that improve the bonding of the second layer **120** to the first layer **110**. For example, in some embodiments, the recess bottom surface **116** can comprise a plurality of circular protrusions, as best shown in FIG. **8**, that increase the surface area and provide mating geometry to couple the second layer **120** to the first layer **110**. Specifically, the first layer **110** comprises four circular protrusions arranged at the top, bottom, toe, and heel portions of the recess bottom surface **116**. In other embodiments, the recess bottom surface **116** may comprise any number, size, and shape of bonding features **113** to improve the bonding of the second layer **120** to the first layer **110**.

[0106] In some embodiments, the first layer **110** is formed of material selected from one or more of the following metallic materials: titanium (Ti), titanium alloy (e.g. Ti-6-4, Ti-8-1-1, T-9S, or BE α-β Ti alloy), aluminum (Al), aluminum alloy, steel, steel alloy, tin, tin alloy, or any other suitable metallic material. In one example, the first layer **110** is formed of titanium alloy Ti-6-4 and the body **101** is formed of titanium alloy Ti-8-1-1.

[0107] The recess created by the recess bottom surface **116** and the recess side wall **118** is configured to receive the second layer **120** that structurally reinforces the first layer **110** to maintain CT and durability while providing an increase in ball speed created by the thin first layer **110**.

[0108] The faceplate **108** further comprises a second layer **120** which is coupled to the first layer rear surface **114** to reinforce the first layer **110** and normalize CT values. Furthermore, the second layer **120** increases the rigidity of the faceplate **108** so that the first layer **110** can be made thinner to increase face flexure and ball speed. As such, the faceplate **108** configuration has increased face flexure and energy transfer properties while being formed from less mass to improve mass properties over a face plate that is made only from a metallic material.

[0109] The second layer **120** comprises a second layer front surface **122** and a second layer rear surface **124**, as best illustrated in FIG. **9**. The second layer **120** further comprises a thickness measured between the second layer front surface **122** and the second layer rear surface **124**. In some embodiments, the thickness of the second layer **120** is constant. In other embodiments, the thickness of the second layer **120** can vary. The thickness of the second layer **120** can range between 0.050 to 0.125 inch. For example, the thickness of the second layer **120** can range between 0.010 to 0.020 inch, 0.02 to 0.03 inch, 0.03 to 0.04 inch, 0.04 to 0.05 inch, 0.05 to 0.06 inch, 0.06 to 0.07 inch, 0.07 to 0.08 inch, 0.08 to 0.09 inch, or 0.09 to 0.10 inch. The second layer **120** thickness can be adjusted to regulate the CT value and durability of the faceplate **108**.
[0110] In some embodiments, a faceplate **108***a* comprises a second layer **120***a* and a first layer **110***a* such that the second layer **120***a* has a thickness that is less than the recess depth wherein the second layer rear surface **124***a* is recessed relative to the first layer rear surface **114***a*, as best illustrated in FIG. **10**A.
[0111] In another embodiment, a faceplate **108***b* comprises a second layer **120***b* and a first layer **110***b* such that the second layer **120***b* has a thickness that is less than the recess depth wherein the second layer **120***b* has a thickness that is equal to the recess depth such that the second layer rear surface **124***b* is flush with the first layer rear surface **114***b*, as best illustrated in FIG. **10**B.
[0112] In another embodiment, a faceplate **108***c* comprises a second layer **120***c* and a first layer **110***c* such that the second layer **120***c* has a thickness that is less than the recess depth wherein the second layer **120***c* has a thickness that is greater than the recess depth such that the second layer rear surface **124***c* protrudes rearwardly relative to the first layer rear surface **114***c*, as best illustrated in FIG. **10**C.
[0113] The second layer **120** may comprise topographic features, such as a curvature or a slope, while still comprising a constant thickness. For example, the curvature or slope of the second layer **120** corresponds to the curvature of the VFT profile of the first layer **110**. As such, in some embodiments, the second layer front surface **122** and the second layer rear surface **124** are not planar. In other embodiments, the second layer front surface **122** and/or the second layer rear surface **124** are planar.
[0114] In an alternative embodiment and according to aspects of the present invention, a golf club head **200** comprises a metallic faceplate and a support ring located on the interior of the body and circumferentially surrounding the faceplate to reinforce and support high stress regions of the body immediately adjacent the faceplate, as best shown in FIG. **11**. Specifically, the golf club head **200** comprises a body **201** having a crown **202**, a sole **203**, and a front opening. The golf club head **200** further comprises a faceplate **208** coupled to the body **201** that is configured to extend over the front opening. The golf club head **200** further comprises a support ring **220** attached to an interior of the body **201** and extending circumferentially around the front opening as best shown in FIG. **11**. The support ring **220**, similar to the second layer **120** described above, reduces CT so that the thickness of the faceplate **208** can be reduced, thereby increasing face flexure and ball speed.
[0115] The support ring **220** comprises the same material as the composite in the previously described second layer **120** and provides reinforcement around the front opening near the crown **202** and the sole **203** through a crown tab **227** and a sole tab **229** that extends from the face into the crown and sole, respectively. Specifically, the crown tab **227** extends rearwardly away from the faceplate **208** along the crown **202**, and the sole tab **229** extends rearwardly away from the faceplate **208** along the sole **203**. These tabs aid in providing additional support in high stress regions, such as the body/face transition areas.
[0116] The crown tab **227** and sole tab **229** may each have a selected length. For instance, the crown tab **227** and/or sole tab **229** may extend the entire width of the crown **202** and sole **203**, respectively, or a percentage of the width of the crown **202** and sole **203**. In some embodiments, the crown tab **227** and sole tab **229** may extend between 10% and 100% of the crown width and sole width, respectively. In other embodiments, the crown tab **227** and sole tab **229** may extend between

10% and 20%, 20% and 30%, 30% and 40%, 40% and 50%, 50% and 60%, 60% and 70%, 70% and 80%, 80% and 90%, or 90% and 100% of the crown width and sole width, respectively. Further, the crown tab **227** and sole tab **229** may be the same length or differing lengths. In some embodiments, the crown tab **227** may be longer than the sole tab **229**, while in other embodiments, the sole tab **229** may be longer than the crown tab **227**.

[0117] Additionally, the crown tab **227** and sole tab **229** may each have a selected width. For instance, the crown tab **227** and/or sole tab **229** may extend the rearward from the front opening. In some embodiments, the crown tab **227** and sole tab **229** may extend rearward from the front opening between 0 inch and 2 inches. In other embodiments, the crown tab **227** and sole tab **229** may extend rearward from the front opening between 0 inch and 0.25 inch, 0.25 inch and 0.50 inch, 0.50 inch and 0.75 inch, 0.75 inch and 1.00 inch, 1.00 inch and 1.25 inches, 1.25 inches and 1.50 inches, 1.50 inches and 1.75 inches, or 1.75 inches and 2.00 inches, respectively. Further, the crown tab **227** and sole tab **229** may be the same width or differing widths. In some embodiments, the crown tab **227** may be wider than the sole tab **229**, while in other embodiments, the sole tab **229** may be wider than the crown tab **227**.

[0118] In an alternative embodiment and according to aspects of the present invention, a golf club head **300** comprises a faceplate having a first layer and a ring shaped second layer coupled the rear surface of the first layer to facilitate the trampoline effect of the recess while maintaining durability, as best shown in FIGS. **12-14**. Specifically, the golf club head **300** comprises a body **301** having a front opening **306** and a faceplate **308** configured to extend over the front opening **306**. The faceplate **308** comprises a first layer **310** having a first layer front surface **312**, a first layer rear surface **314**, a recess bottom surface **316** extending from the first layer rear surface **314** towards the first layer front surface **312**, and a recess side wall **318**, wherein the recess bottom surface **316** and recess side wall **318** define a recess. The faceplate **308** further comprises a support ring **320** attached the first layer rear surface **314** having a support ring rear surface **324**, a support ring front surface **322**, and a support ring inner surface **326**, wherein the support ring inner surface **326** is aligned or continuous with the recess side wall **318**. The recess is bounded by the support ring **320** to increase the trampoline effect while maintaining sufficient durability.

[0119] The recess **330** is bounded by the recess side wall **318** and the support ring inner surface **326**. Since the recess side wall **318** and the support ring inner surface **326** are aligned, the two coupled pieces form an effectively deeper recess **330**. The recess side wall **318** has a height measured from the recess bottom surface **316**. In some embodiments, the recess side wall **318** is between 0.001 inch and 0.150 inch. In other embodiments, the recess side wall may be between 0.001 inch and 0.010 inch, 0.010 inch and 0.020 inch, 0.020 inch and 0.030 inch, 0.030 inch and 0.040 inch, 0.040 inch and 0.050 inch, 0.050 inch and 0.060 inch, 0.060 inch and 0.070 inch, 0.070 inch and 0.080 inch, 0.080 inch and 0.090 inch, 0.090 inch and 0.100 inch, 0.100 inch and 0.110 inch, 0.110 inch and 0.120 inch, 0.120 inch and 0.130 inch, 0.130 inch and 0.140 inch, or 0.140 inch and 0.150 inch. The support ring inner surface **326** height is determined by the thickness of the support ring **320**. In some embodiments the support ring **320** may have a thickness between 0.010 inch and 0.125 inch. In other embodiments, the support ring **320** may have a thickness between 0.010 inch and 0.020 inch, 0.020 inch and 0.030 inch, 0.030 inch and 0.040 inch, 0.040 inch and 0.050 inch, 0.050 inch and 0.060 inch, 0.060 inch and 0.070 inch, 0.070 inch and 0.080 inch, 0.080 inch and 0.090 inch, 0.090 inch and 0.100 inch, 0.100 inch and 0.110 inch, or 0.110 inch and 0.125 inch.

[0120] The support ring **320** comprises a width measured from a support ring outer surface **328** to the support ring inner surface **326** that can be selected to adjust the stiffness and flexure of the faceplate **308**. The support ring **320** width can range from 0.10 inch to 1.5 inches. For example, in some embodiments, the support ring **320** width can range between 0.10 inch and 0.24 inch, 0.24 inch and 0.38 inch, 0.38 inch and 0.52 inch, 0.52 inch and 0.66 inch, 0.66 inch and 0.80 inch, 0.80 inch and 0.94 inch, 0.94 inch and 1.08 inches, 1.08 inches and 1.22 inches, 1.22 inches and 1.36

inches, or 1.36 inches and 1.50 inches.

[0121] The support ring **320** can be spaced away from a geometric center of the faceplate **308** at distance ranging between 0.10 inch and 1.0 inch. For example, in some embodiments, the support ring **320** can be offset from the geometric center by a distance ranging from 0.10 inch and 0.19 inch, 0.19 inch and 0.28 inch, 0.28 inch and 0.37 inch, 0.37 inch and 0.46 inch, 0.46 inch and 0.55 inch, 0.55 inch and 0.64 inch, 0.64 inch and 0.73 inch, 0.73 inch and 0.82 inch, 0.82 inch and 0.91 inch, or 0.91 inch and 1.00 inch. In some embodiments, the support ring **320** can be offset from the geometric center by a distance that is greater than 0.10 inch, 0.15 inch, 0.20 inch, 0.25 inch, 0.30 inch, 0.35 inch, 0.40 inch, 0.45 inch, 0.50 inch, 0.55 inch, 0.60 inch, 0.65 inch, 0.70 inch, 0.75 inch, 0.80 inch, 0.85 inch, 0.90 inch, 0.95 inch, or greater than 1.00 inch. The distance the support ring **320** is spaced away from the geometric center of the faceplate **308** can be selected to alter the stiffness and flexure of the faceplate **308**.

[0122] In an alternative embodiment and according to aspects of the present invention, a golf club head **400** comprises a two-layer faceplate and an arcuate strut that supports the rear surface of the faceplate to further reinforce and increase durability of the faceplate, as best shown in FIGS. **15** and **16**. Specifically, a golf club head **400** comprises a body **401** having a crown **402**, a sole **403**, and a front opening **406**. The body **401** further comprises a crown retainer **434** located on an interior surface of the crown **402** proximate the front opening **406**, a sole retainer **432** located on an interior surface of the sole **403** proximate the front opening **406**. The golf club head **400** further comprises an arcuate strut **440** having a top end **444** that is coupled to the crown retainer **434**, and a bottom end **442** that is coupled to the sole retainer **432** and a faceplate **408** coupled to the body **401** and configured to extend over the front opening **406**. The faceplate comprises a first layer **410** and a second layer **420**, wherein the arcuate strut **440** abuts the second layer **420**. The arcuate strut **440** serves as a structural reinforcement system that directly contacts and supports the faceplate **408**.

[0123] The sole retainer **432**, the crown retainer **434**, and the arcuate strut **440** are generally positioned at a central location relative the faceplate. This allows the arcuate strut **440** to brace the least supported region of the faceplate **408**. The arcuate strut **440** abuts the second layer **420**, thus providing additional support to the coupling of the second layer **420** to the first layer **410**.

[0124] The arcuate strut **440** has a thickness and width. The thickness of the arcuate strut **440** may be between 0.03 inch and 0.30 inch. In some embodiments, the thickness of the arcuate strut **440** may be between 0.03 inch and 0.06 inch, 0.06 inch and 0.09 inch, 0.09 inch and 0.12 inch, 0.12 inch and 0.15 inch, 0.15 inch and 0.18 inch, 0.18 inch and 0.21 inch, 0.21 inch and 0.24 inch, 0.24 inch and 0.27 inch, or 0.27 inch and 0.30 inch. The width of the arcuate strut **440** may be between 0.1 inch and 1.0 inch. In alternative embodiments, the width of the arcuate strut **440** may be between 0.1 inch and 0.2 inch, 0.2 inch and 0.3 inch, 0.3 inch and 0.4 inch, 0.4 inch and 0.5 inch, 0.5 inch and 0.6 inch, 0.6 inch and 0.7 inch, 0.7 inch and 0.8 inch, 0.8 inch and 0.9 inch, or 0.9 inch and 1.0 inch.

[0125] The sole retainer **432** and the crown retainer **434** may be positioned rearward of the front opening **406**. This gives the arcuate strut **440** space to abut the second layer **420** and provide a reinforcing force to the faceplate **408**. In some embodiments, the sole retainer **432** and crown retainer **434** may be positioned between 0 inch and 1.0 inch rearward of the front opening **406**. In other embodiments, the sole retainer **432** and crown retainer **434** may be positioned between 0 inch and 0.1 inch, 0.1 inch and 0.2 inch, 0.2 inch and 0.3 inch, 0.3 inch and 0.4 inch, 0.4 inch and 0.5 inch, 0.5 inch and 0.6 inch, 0.6 inch and 0.7 inch, 0.7 inch and 0.8 inch, 0.8 inch and 0.9 inch, or 0.9 inch and 1.0 inch rearward of the front opening **406**.

[0126] The first layer **410** and second layer **420** are similar to the first layer **110** and second layer **120** described above, in that the first layer **410** comprises a recess configured to receive the second layer **420** to increase ball speed while regulating CT values.

[0127] In an alternative embodiment and according to aspects of the present invention, a golf club head **500** comprises a two-layer faceplate and an arcuate strut that supports the rear surface of the faceplate to further reinforce and increase durability of the faceplate, similar to the golf club head **400** described above. In this embodiment, the arcuate strut spans heel to toe, as best shown in FIGS. **17** and **18**, as an alternative to spanning crown to sole in the golf club head **400** described above. Specifically, the golf club head **500** comprises a body **501** having a heel **504**, a toe **505**, and a front opening **506**. The body **501** further comprises a heel retainer **531** located on an interior surface of the heel **504** proximate the front opening **506**, a toe retainer **533** located on an interior surface of the toe **505** proximate the front opening **506**. The golf club head **500** further comprises an arcuate strut **540** having a heel end **541** that is coupled to the heel retainer **531**, and a toe end **543** that is coupled to the toe retainer **533** and a faceplate **508** coupled to the body **501** and configured to extend over the front opening **506**. The faceplate comprises a first layer **510** and a second layer **520**, wherein the arcuate strut **540** abuts the second layer **520**. The arcuate strut **540** serves as a structural reinforcement system that directly contacts and supports the faceplate **508**.

[0128] The heel retainer **531**, the toe retainer **533**, and the arcuate strut **540** are generally positioned at a central location relative the faceplate **508**. This allows the arcuate strut **540** to brace the least supported region of the faceplate **508**. The arcuate strut **540** abuts the second layer **520**, thus providing additional support to the coupling of the second layer **520** to the first layer **510**.

[0129] The arcuate strut **540** has a thickness and width. The thickness of the arcuate strut **540** may be between 0.03 inch and 0.30 inch. In some embodiments, the thickness of the arcuate strut **540** may be between 0.03 inch and 0.06 inch, 0.06 inch and 0.09 inch, 0.09 inch and 0.12 inch, 0.12 inch and 0.15 inch, 0.15 inch and 0.18 inch, 0.18 inch and 0.21 inch, 0.21 inch and 0.24 inch, 0.24 inch and 0.27 inch, or 0.27 inch and 0.30 inch. The width of the arcuate strut **540** may be between 0.1 inch and 1.0 inch. In alternative embodiments, the width of the arcuate strut **540** may be between 0.1 inch and 0.2 inch, 0.2 inch and 0.3 inch, 0.3 inch and 0.4 inch, 0.4 inch and 0.5 inch, 0.5 inch and 0.6 inch, 0.6 inch and 0.7 inch, 0.7 inch and 0.8 inch, 0.8 inch and 0.9 inch, or 0.9 inch and 1.0 inch.

[0130] The heel retainer **531** may be positioned heelward of the front opening **506** to give the arcuate strut **540** space to abut the second layer **520** and provide a reinforcing force to the faceplate **508**. In some embodiments, the heel retainer **531** may be positioned between 0 inch and 1.0 inch heelward of the front opening **506**. In other embodiments, the heel retainer **531** may be positioned between 0 inch and 0.1 inch, 0.1 inch and 0.2 inch, 0.2 inch and 0.3 inch, 0.3 inch and 0.4 inch, 0.4 inch and 0.5 inch, 0.5 inch and 0.6 inch, 0.6 inch and 0.7 inch, 0.7 inch and 0.8 inch, 0.8 inch and 0.9 inch, or 0.9 inch and 1.0 inch heelward of the front opening **506**.

[0131] The toe retainer **533** may be positioned toeward of the front opening **506** to give the arcuate strut **540** space to abut the second layer **520** and provide a reinforcing force to the faceplate **508**. In some embodiments, the toe retainer **533** may be positioned between 0 inch and 1.0 inch toeward of the front opening **506**. In other embodiments, the toe retainer **533** may be positioned between 0 inch and 0.1 inch, 0.1 inch and 0.2 inch, 0.2 inch and 0.3 inch, 0.3 inch and 0.4 inch, 0.4 inch and 0.5 inch, 0.5 inch and 0.6 inch, 0.6 inch and 0.7 inch, 0.7 inch and 0.8 inch, 0.8 inch and 0.9 inch, or 0.9 inch and 1.0 inch toeward of the front opening **506**.

[0132] In another faceplate embodiment, and according to aspects of the present invention, the golf club head **600** comprises a faceplate that is adhesively coupled to the body, instead of welding, so that the composite backing layer may extend to the perimeter of the first layer increasing the supported area of the first layer, as best shown in FIGS. **19** and **20**. The first layer **610** comprises a front surface **612**, a rear surface **614**, and a perimeter surface **615**. The front surface **612** is opposite the rear surface **614** and is used to strike a ball. The rear surface **614** is adhered to a second layer **620** to create a faceplate **608**. The perimeter surface **615** extends around the entirety of the outer border, and connects, the front surface **612** and rear surface **614**. The width of the perimeter surface, measured perpendicular to the front surface **612**, is equivalent to the thickness of the first layer **610**. The first layer **610** of the faceplate **608** allows for a durable strike face, exhibiting a desirable sound and feel for most golfers.

[0133] The first layer thickness may vary across the entire first layer **610**. This allows for a VFT to improve performance on off-center hits. Further, the first layer **610** may have a thin region **619**, around the perimeter of the first layer **610**, that creates a step. The step allows for the faceplate **608** to be adhered to the golf club head via a lap joint **602**. The thin region **619** runs fully around the first layer **610**. Further, the thin region **619** comprises a thin region length that extends inward from the outer perimeter of the first layer, perpendicular to the edge of the first layer. In some embodiments, the thin region **619** length can be between 0.090 inch and 0.210 inch. In some embodiments, the thin region **619** length can be between 0.090 inch and 0.100 inch, 0.100 inch and 0.110 inch, 0.110 inch and 0.120 inch, 0.120 inch and 0.130 inch, 0.130 inch and 0.140 inch, 0.140 inch and 0.150 inch, 0.150 inch and 0.160 inch, 0.160 inch and 0.170 inch, 0.170 inch and 0.180 inch, 0.180 inch and 0.190 inch, 0.190 inch and 0.200 inch, or 0.200 inch and 0.210. In one exemplary embodiment, the thin region **619** length is 0.196 inch. The thin region **619** length can vary or remain constant throughout the thin region **619** to customize the surface area contact between the faceplate **608** and the lap joint **602**.

[0134] The faceplate **608** further comprises a second layer **620** having three surfaces: a composite front surface **622**; a composite rear surface **624**; and a composite perimeter surface **628**. The composite front surface **622** is adhered to the rear surface **614** to form the faceplate **608**. Further, the composite rear surface **624** is opposite the composite front surface **622**, and the composite perimeter surface **628** extends around the entirety of the outer border, bound by the composite front surface **622** plane and the composite rear surface **624** plane. The second layer **620** increases the rigidity of the overall faceplate **608** so that the first layer **610** can be made thinner to increase discretionary mass and face flexure. As such, the faceplate **608** constructed from the metal-composite construction has increased face flexure and energy transfer properties while being formed from less mass to improve mass properties over a face plate that is made only from a metallic material.

[0135] In different embodiments, the thickness of the second layer **620** may differ. In one embodiment, the second layer **620** is a constant thickness when measured normal to the rear surface **614**. The second layer **620** may follow the contours and VFT of the first layer **610** without varying in thickness. In other embodiments, the second layer **620** may comprise a variable thickness across the faceplate **608** that supports the first layer **610**. The thickness of the second layer **620** can range from 0.01 inch to 0.10 inch. For example, in some embodiments, the thickness of the second layer **620** can range from 0.01 to 0.02 inch, 0.02 to 0.03 inch, 0.03 to 0.04 inch, 0.04 to 0.05 inch, 0.05 to 0.06 inch, 0.06 to 0.07 inch, 0.07 to 0.08 inch, 0.08 to 0.09 inch, or 0.09 to 0.10 inch.

[0136] The composite layup of the second layer **620**, such as number of layers, materials, fiber orientation, fiber lengths, and the like described above can be applied to the second layer **620** in the illustrated embodiment to achieve a desired thickness, mass, and/or rigidity.

[0137] The first layer **610** and the second layer **620** are coupled together to form the faceplate **608**. In some embodiments, the second layer **620** and the first layer **610** line-up such that the perimeter surface **615** and the composite perimeter surface **628** are flush fully around the faceplate **608**. In other embodiments, the second layer **620** may be smaller, wherein the composite perimeter surface **628** is offset from the perimeter surface **615**. Coupling the second layer **620** to the first layer **610** can be done through the use of an adhesive or other methods. Coupling the two layers creates a structure that is lighter than a fully metallic faceplate, but still retains a desired durability, sound, and feel.

[0138] The faceplate **608** fits within a front opening **606** on the body **601**. Support for the faceplate **608** comes from a recessed lap joint **602**, that allows the faceplate **608** to set flush with the golf club head body. Further, the lap joint **602** structure provides a bonding surface to couple the faceplate **608** to the golf club head. The bonding surface is made up of two distinct lap joint **602** surfaces, including a lap joint front surface **604** and a lap joint shoulder **603**, that may accept an adhesive to secure the faceplate **608** to the golf club head body. In some embodiments, the lap joint front surface length **642** matches the length of the thin region **619**. In other embodiments, the lap joint front surface length **642** may be shorter than the length of the thin region **619** or vary in length around the front opening **606**. In some embodiments, the lap joint front surface length **642** can be between 0.090 inch and 0.210 inch. In some embodiments, the lap joint front surface length **642** can be between 0.090 inch and 0.100 inch, 0.100 inch and 0.110 inch, 0.110 inch and 0.120 inch, 0.120 inch and 0.130 inch, 0.130 inch and 0.140 inch, 0.140 inch and 0.150 inch, 0.150 inch and 0.160 inch, 0.160 inch and 0.170 inch, 0.170 inch and 0.180 inch, 0.180 inch and 0.190 inch, 0.190 inch and 0.200 inch, or 0.200 inch and 0.210. The lap joint front surface length **642** can vary or remain constant throughout the lap joint **602** to customize the surface area contact between the faceplate **608** and the lap joint **602**.

[0139] The lap joint shoulder **603** provides a recess from the front of the golf club head to accommodate the thickness of the faceplate **608**. The lap joint shoulder length **640** matches the thickness of the sum of the second layer **620** thickness and thin region **619** thickness. This provides a faceplate **608** that sets flush with the golf club head body. The lap joint shoulder **603** also provides additional bonding area that extends fully around the front opening **606**.

[0140] The second layer can be attached to the first layer by adhesive attachment, mechanical fastening, co-molding, or other various forms of attachment to securely fasten the second layer to the first layer to prevent detachment of the second layer during impact with a golf ball. In some embodiments, the second layer is adhered to the first layer through a double side VHB tape. In other embodiments, the second layer can be attached to the first layer through a layer of thermoplastic resin that liquefies when heated and solidifies when cooled to form a high strength bond. In other embodiments, the second layer can be mechanically fastened to the first layer via rivets, screws, nuts, bolts, washers, or any other similar mechanical fastener.

[0141] In one embodiment, a golf club head **700** can comprise a faceplate **708** with a first layer **710** and a second layer **720** that are coupled together with a plurality of rivets **730** to increase bond strength and durability of the faceplate **708**, as best illustrated in FIGS. **21-23**. The rivets comprise a head **732**, a rounded tip end **734**, and a neck **736** extending between the head **732** and the rounded tip end **734**. The rounded tip end **734** mechanically locks the second layer **720** to the first layer **710**. The faceplate **708** is similar to the faceplate **108** described above in that the faceplate **708** comprises a first layer **710** composed of a metallic material having a first layer front surface **712**, a first layer rear surface **714**, and a recess formed on the first layer rear surface **714** extending towards the first layer front surface **712** and bounded by a recess bottom surface **716** and a recess side wall **718**. The faceplate **708** further comprises a second layer **720** composed of a fiber-reinforced composite layer and having a second layer rear surface **724** and a second layer front surface **722** abutting the first layer rear surface **714**.

[0142] The head **732** is exposed to the exterior of the faceplate **708** while the rounded tip end **734** is exposed to the interior cavity. The rivet **730** extends entirely through the second layer rear surface **724**, the second layer front surface **722**, the recess bottom surface **716**, and the first layer front surface **712**. The first layer front surface **712** comprises countersunk walls **738** so that the head **732** of the rivet can remain flush with the first layer front surface **712**. Accordingly, the head **732** of the rivet comprises corresponding geometry with the countersunk walls **738**.

[0143] The rounded tip end **734** is created during the riveting process and overlaps with the second layer rear surface **724** to mechanically lock the second layer **720** to the first layer **710** and prevent translation of the second layer **720** relative to the first layer **710**.

[0144] The faceplate **708** can comprise one or more rivets **730** to securely fasten the second layer **720** to the first layer **710**. Increasing the number of rivets **730** increases the bond strength between the second layer **720** and the first layer **710**. Furthermore, the size of the rivets **730** such as the diameter of the head **732** or diameter of the neck **736** to minimize surface area of the head **732** exposed on the first layer front surface **712** or to reduce weight.

[0145] In another embodiment according to aspects of the present invention, a golf club head **800** can comprise a mechanical fastener system that includes at least a screw **840**, a nut **844**, and a washer **842**, as best illustrated in FIGS. **24-26**, to improve bonding and attachment of the second layer **820** to the first layer **810**. Similar to the rivets **730** described above, the at least one screw **840** extends completely through the second layer **820** and the first layer **810** such that the at least one screw **840** is exposed to the exterior of the golf club head **800**, as illustrated in FIG. **25**. Accordingly, the first layer **810** and the second layer **820** comprise corresponding and concentric apertures that receive the shaft of the screw **840**. The at least one washer **842** and at least one nut **844** are positioned adjacent the second layer rear surface **824**, exposed to the interior cavity of the body **801**.

[0146] The faceplate **808** is similar to the faceplate **708** described above in that the faceplate **808** comprises a first layer **810** composed of a metallic material having a first layer front surface **812**, a first layer rear surface **814**, and a recess formed on the first layer rear surface **814** extending towards the first layer front surface **812** and bounded by a recess bottom surface **816** and a recess side wall **818**. The faceplate **808** further comprises a second layer **820** composed of a fiber-reinforced composite layer and having a second layer rear surface **824** and a second layer front surface **822** abutting the first layer rear surface **814**.

[0147] In some embodiments, the faceplate **808** can comprise a plurality of apertures configured to receive an equal number of screws **840**, nuts **844**, and washers **842**. For example, in some embodiments, the faceplate **808** can comprise two apertures, two screws **840**, two nuts **844**, and two washers **842**. In other embodiments, the faceplate **808** can comprise three, four, five, or more apertures, screws **840**, nuts **844**, and washers **842** to achieve a desired durability and bond strength of the second layer **820** to the first layer **810**.

EXAMPLES

I. Example 1: Robot Test Comparing Ball Speed and CT

[0148] A robotic test was conducted to compare the ball speeds and CT values of an exemplary club head, according to aspects of the present invention, to a control club head. Each club head was placed into a robotic device that simulated a player's swing. The robot was programmed to impact the ball at the geometric center and to deliver each club with the same impact dynamics. The average ball speed was recorded for each club. After the robot test, the CT was measured using the CT test apparatus approved by the USGA. Table 1 below illustrates the average ball speed and CT for each club.

[0149] The exemplary club head comprised a MC faceplate according to aspects of the present invention. The MC faceplate was similar to the faceplate illustrated in FIGS. **1-9**, that comprised a metallic strike face insert having a recess on the rear surface. The recess received a composite sheet. The MC faceplate used in the test had a recess depth of 0.020 inch, a composite thickness of 0.035 inch, a perimeter offset distance of 0.160 inch, a maximum metallic thickness of 0.102 inch, and a minimum metallic thickness of 0.052 inch. The control club head was similar to the exemplary club head in all ways, except for the strike face insert. The control club head had only a metallic strike face insert with no recess and no composite backing layer.

TABLE-US-00001 TABLE 1 Ball Speed and CT Comparison Exemplary Club Head Control Club Head Average Ball Speed 154.7 mph 153.9 mph CT 241 μs 238 μs

[0150] As shown in Table 1 above, the exemplary club head had an average ball speed of 154.7 mph at the geometric center while the control club head had an average ball speed of 153.9 mph. Furthermore, the exemplary club head had a CT value of 241 μs while the control club head had a CT value of 238 μs. The exemplary club head had a CT value that was 3 μs higher than the control club head, which is within the range of error of the measuring apparatus. As such, the exemplary club head exhibited an 0.8 mph increase in ball speed over the control club head with the same impact dynamics and having approximately the same CT value. As such, the exemplary club head comprise a metallic strike face insert with a recess that receives a composite backing layer results in an increased ball speed for the same CT values and under the same impact dynamics

II. Example 2: Durability Test

[0151] A durability test was performed to assess the durability effects of mechanical locking features on a composite backed face plate. The durability test was conducted using an air cannon that shot a golf ball at 100 mph at a control club head and an exemplary club head. The air cannon ran until each club head failed and/or cracked then the total number of shots was recorded. The test ran 4 identical control club heads and 4 identical exemplary club heads. Table 2 below shows the average number of shots till failure for the control club head and the average number of shots till failure for the exemplary club head.

[0152] The exemplary club head comprise a metallic strike face insert with a rear recess that received a composite backing layer. The exemplary club head further comprises four rivets to secure the composite backing layer to the metallic strike face, similar to the strike face illustrated in FIGS. **21-23**. The exemplary club head had a recess depth of 0.020 inch, a composite thickness of 0.020 inch, a perimeter offset distance of 0.160 inch, a maximum metallic thickness of 0.102 inch, and a minimum metallic thickness of 0.052 inch. The control club head was similar to the exemplary club in all aspects, including the dimensions listed above, except that the control club head did not have rivets. Instead, the control club head only used epoxy to secure the composite backing layer to the recess. The control club head had the same dimensions as the exemplary club head listed above.

TABLE-US-00002 TABLE 2 Durability Comparison Exemplary Club Head Control Club Head Average Number of 3201 shots 1312 shots Shots till Failure

[0153] As shown in Table 2 above, the exemplary club head comprising mechanical attachment features exhibited a 144% increase in durability over the control club head. The exemplary club head that comprised rivets had an average of 3201 shots to failure while the control club head that lacked rivets had an average of 1312 shots to failure. Accordingly, the exemplary club head had an increase of 1889 shots over the control club head. The drastic increase in durability exhibited by the exemplary club head can be attributed to the use of mechanical attachment means, such as rivets.

III. Example 3: FEA Study

[0154] A Finite Element Analysis (FEA) test using Computer Aided Design (CAD) software was ran to determine the relative CT values of a control club head and an exemplary club head. The relative CT values, or changes in CT values, are accurate and representative of the physical parts for this study. All definitions, parameters, and constraints used in the software to setup the simulation were the same between the control club head and the exemplary club head. Accordingly, the differences recorded during the simulation can be attributed to the different designs.

[0155] The exemplary club head was similar to the club head illustrated in FIG. **11** and comprised a perimeter reinforcement ring extended around the circumference of the rear surface of the strike face. The reinforcement ring was coupled to an interior surface of the body, and not the faceplate. The reinforcement ring comprises a crown tab and a sole tab, similar to the embodiment illustrated in FIG. **11**.

[0156] The FEA software demonstrated that the exemplary club head had a CT value of 225 μs while the control club head had a CT value of 239 μs. As such, the exemplary club head comprising the reinforcement ring was able to reinforce and support the faceplate to result in a reduction in CT by 14 μs, confirming the effectiveness of the reinforcement ring.

CLAUSES

[0157] Clause 1. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is less than a depth of the recess.

[0158] Clause 2. The golf club head of clause 1, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a rivet.

[0159] Clause 3. The golf club head of clause 1, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a screw, a nut, and a washer.

[0160] Clause 4. The golf club head of clause 1, wherein the second layer is adhesively coupled to the first layer.

[0161] Clause 5. The golf club head of clause 1, wherein the first layer comprises a variable face thickness.

[0162] Clause 6. The golf club head of clause 5, wherein the second layer comprises a constant thickness.

[0163] Clause 7. The golf club head of clause 6, wherein the second layer front surface and the second layer rear surface are not planar.

[0164] Clause 8. The golf club head of clause 1, wherein the second layer comprises a thickness between 0.010 inch and 0.025 inch.

[0165] Clause 9. The golf club head of clause 8, wherein the first layer comprises a recess depth measured as a distance between the first layer rear surface and the recess bottom surface that ranges between 0.010 inch and 0.050 inch.

[0166] Clause 10. The golf club head of clause 9, wherein the first layer comprises a first thickness measured from the recess bottom surface to the first layer front surface that ranges from 0.050 to 0.080 inch.

[0167] Clause 11. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is equal to a depth of the recess such that the second layer rear surface is flush with the first layer rear surface.

[0168] Clause 12. The golf club head of clause 11, wherein the first layer comprises a first thickness measured from the recess bottom surface to the first layer front surface that ranges from 0.050 to 0.080 inch.

[0169] Clause 13. The golf club head of clause 12, wherein the first layer comprises an offset distance that is measured between a perimeter wall and the recess side wall that ranges between 0.050 inch and 0.150 inch.

[0170] Clause 14. The golf club head of clause 11, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a rivet.

[0171] Clause 15. The golf club head of clause 11, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a screw, a nut, and a washer.

[0172] Clause 16. The golf club head of clause 11, wherein the second layer is adhesively coupled to the first layer.

[0173] Clause 17. The golf club head of clause 11, wherein the first layer comprises a variable face thickness.

[0174] Clause 18. The golf club head of clause 17, wherein the second layer comprises a constant

thickness.
[0175] Clause 19. The golf club head of clause 18, wherein the second layer front surface and the second layer rear surface are not planar.
[0176] Clause 20. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is less than a depth of the recess; wherein the second layer has a thickness that is greater than a depth of the recess such that the second layer rear surface protrudes rearwardly relative to the first layer rear surface.
[0177] Clause 21. A golf club head, comprising: a body having a crown, a sole, and a front opening; and a faceplate coupled to the body and configured to extend over the front opening; and a support ring attached to an interior of the body and extending circumferentially around the front opening, the support ring comprising: a sole tab extending rearwardly away from the faceplate along the sole; and a crown tab extending rearwardly away from the faceplate along the crown.
[0178] Clause 22. The golf club head of clause 21, wherein the sole tab extends between 10% and 100% of a sole width.
[0179] Clause 23. The golf club head of clause 21, wherein the crown tab extends between 10% and 100% of a crown width.
[0180] Clause 24. The golf club head of clause 21, wherein the sole tab is longer than the crown tab.
[0181] Clause 25. The golf club head of clause 21, wherein the crown tab is longer than the sole tab.
[0182] Clause 26. The golf club head of clause 21, wherein a sole tab length and a crown tab length are equal.
[0183] Clause 27. The golf club head of clause 21, wherein the sole tab extends rearward from the front opening between 0 inch and 2 inches.
[0184] Clause 28. The golf club head of clause 21, wherein the crown tab extends rearward from the front opening between 0 inch and 2 inches.
[0185] Clause 29. The golf club head of clause 21, wherein the faceplate comprises a variable face thickness.
[0186] Clause 30. The golf club head of clause 21, wherein the support ring comprises a constant thickness.
[0187] Clause 31. The golf club head of clause 21, wherein the support ring comprises a thickness between 0.050 inch and 0.125 inch.
[0188] Clause 32. A golf club head, comprising: a body having a front opening; and a faceplate configured to extend over the front opening, the faceplate comprising: a first layer having a first layer front surface, a first layer rear surface, a recess bottom surface extending from the first layer rear surface towards the first layer front surface, and a recess side wall, wherein the recess bottom surface and recess side wall define a recess; a support ring attached to the first layer rear surface having a support ring rear surface, a support ring front surface, and a support ring inner surface, wherein the support ring inner surface is aligned/continuous with the recess side wall.
[0189] Replacement of one or more claimed elements constitutes reconstruction and not repair. Additionally, benefits, other advantages, and solutions to problems have been described with regard to specific embodiments. The benefits, advantages, solutions to problems, and any element or elements that may cause any benefit, advantage, or solution to occur or become more pronounced, however, are not to be construed as critical, required, or essential features or elements of any or all

of the claims, unless such benefits, advantages, solutions, or elements are stated in such claim.
[0190] Moreover, embodiments and limitations disclosed herein are not dedicated to the public under the doctrine of dedication if the embodiments and/or limitations: (1) are not expressly claimed in the claims; and (2) are or are potentially equivalents of express elements and/or limitations in the claims under the doctrine of equivalents.

Claims

1. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is less than a depth of the recess.
2. The golf club head of claim 1, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a rivet.
3. The golf club head of claim 1, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a screw, a nut, and a washer.
4. The golf club head of claim 1, wherein the second layer is adhesively coupled to the first layer.
5. The golf club head of claim 1, wherein the first layer comprises a variable face thickness.
6. The golf club head of claim 5, wherein the second layer comprises a constant thickness.
7. The golf club head of claim 6, wherein the second layer front surface and the second layer rear surface are not planar.
8. The golf club head of claim 1, wherein the second layer comprises a thickness between 0.010 inch and 0.025 inch.
9. The golf club head of claim 8, wherein the first layer comprises a recess depth measured as a distance between the first layer rear surface and the recess bottom surface that ranges between 0.010 inch and 0.050 inch.
10. The golf club head of claim 9, wherein the first layer comprises a first thickness is measured from the recess bottom surface to the first layer front surface that ranges from 0.050 to 0.080 inch.
11. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is equal to a depth of the recess such that the second layer rear surface is flush with the first layer rear surface.
12. The golf club head of claim 11, wherein the first layer comprises a first thickness is measured from the recess bottom surface to the first layer front surface that ranges from 0.050 to 0.080 inch.
13. The golf club head of claim 12, wherein the first layer comprises an offset distance that is measured between a perimeter wall and the recess side wall that ranges between 0.050 inch and 0.150 inch.
14. The golf club head of claim 11, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a rivet.

15. The golf club head of claim 11, further comprising a mechanical fastener configured to mechanically fasten the second layer to the first layer, wherein the mechanical fastener comprises a screw, a nut, and a washer.

16. The golf club head of claim 11, wherein the second layer is adhesively coupled to the first layer.

17. The golf club head of claim 11, wherein the first layer comprises a variable face thickness.

18. The golf club head of claim 17, wherein the second layer comprises a constant thickness.

19. The golf club head of claim 18, wherein the second layer front surface and the second layer rear surface are not planar.

20. A golf club head, comprising: a body having a front opening; and a faceplate coupled to the body and configured to extend over the front opening, the faceplate comprising: a first layer composed of a metallic material and having a first layer front surface, a first layer rear surface, and a recess formed on the first layer rear surface extending towards the first layer front surface and bounded by a recess bottom surface and a recess side wall; and a second layer composed of a fiber-reinforced composite layer and having a second layer rear surface and a second layer front surface abutting the first layer rear surface; wherein the second layer has a thickness that is less than a depth of the recess; wherein the second layer has a thickness that is greater than a depth of the recess such that the second layer rear surface protrudes rearwardly relative to the first layer rear surface.