US 20150165278A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2015/0165278 A1**

(43) **Pub. Date: Jun. 18, 2015**

Oberg

(54) **APPARATUS AND METHOD FOR LASER MARKING GOLF BALLS**

(71) Applicant: **Troy Gary Oberg**, Dassel, MN (US)

(72) Inventor: **Troy Gary Oberg**, Dassel, MN (US)

(21) Appl. No.: **14/571,499**

(22) Filed: **Dec. 16, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/917,214, filed on Dec. 17, 2013.

Publication Classification

(51) **Int. Cl.**

A63B 45/02 (2006.01)

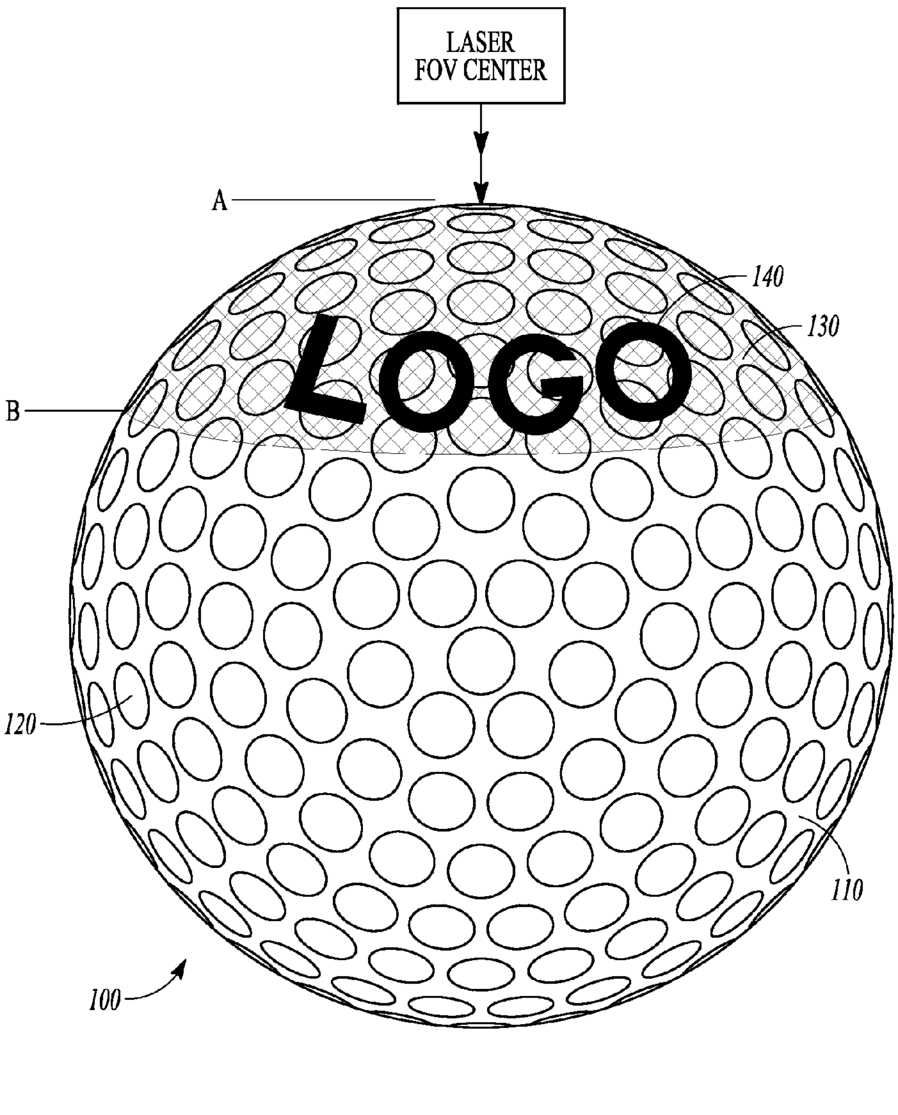
A63B 37/00 (2006.01)

(52) **U.S. Cl.**

CPC *A63B 45/02* (2013.01); *A63B 37/0003* (2013.01); *A63B 37/0004* (2013.01)

(57) **ABSTRACT**

A method for laser marking a golf ball includes providing a golf ball including a core and a shell. Infusing the shell of the golf ball with a laser marking substrate including an initial substrate color, wherein shell includes an exterior surface and an original shell color. Marking the golf ball while maintaining an original shape of the exterior surface between a pre-marked configuration and a post-marked configuration. Marking the golf ball further including exposing a portion of the shell to a laser beam, and modifying the original shell color of the portion of the shell exposed to the laser beam. The modification of the original shell color corresponds to an alteration of the initial substrate color in response to exposure to the laser, wherein the alternation of the initial substrate color is within the shell.



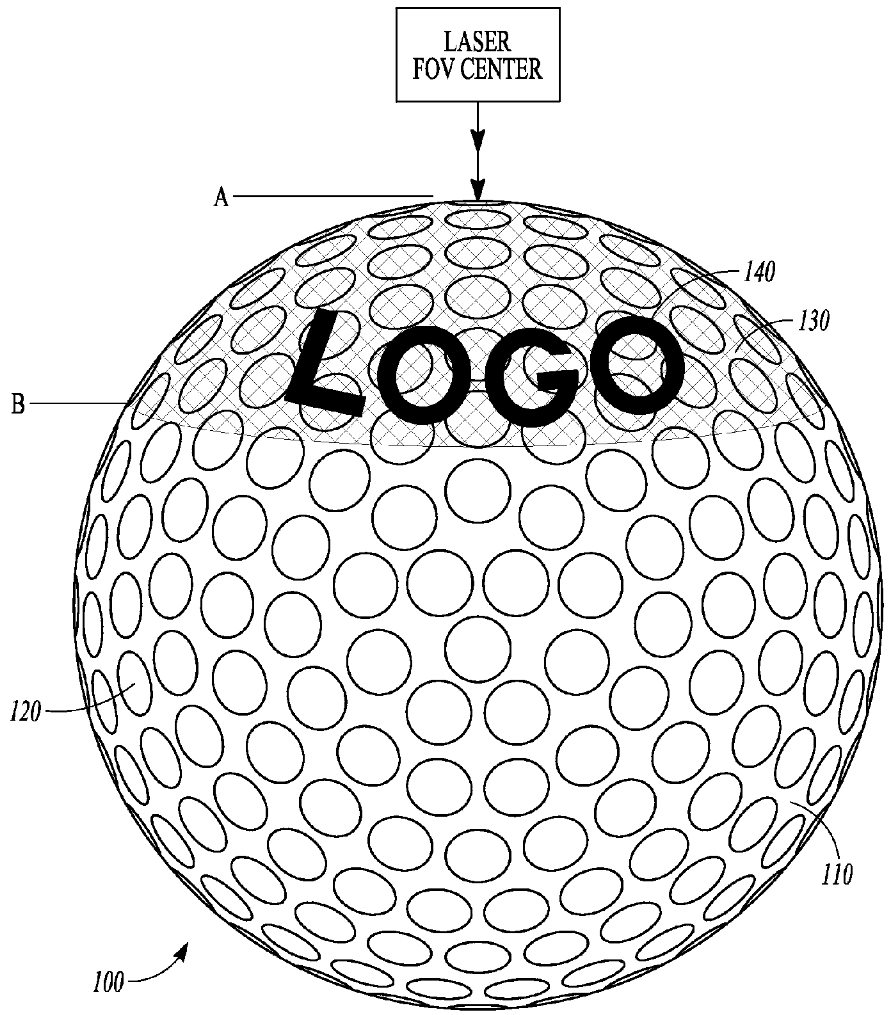


FIG. 1

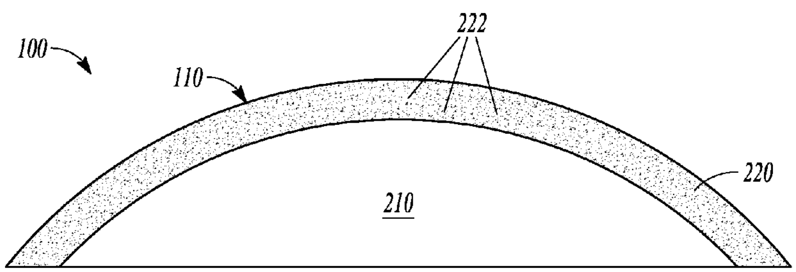

100
110
222
220
210

FIG. 2

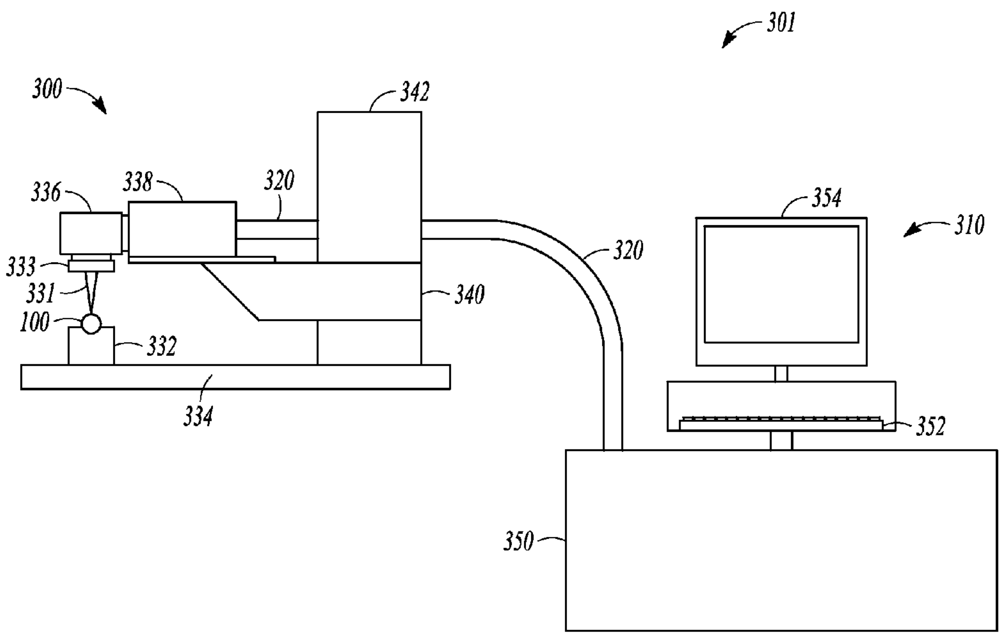

301
300
342
336
338
320
354
310
320
333
331
340
100
332
352
334
350

FIG. 3

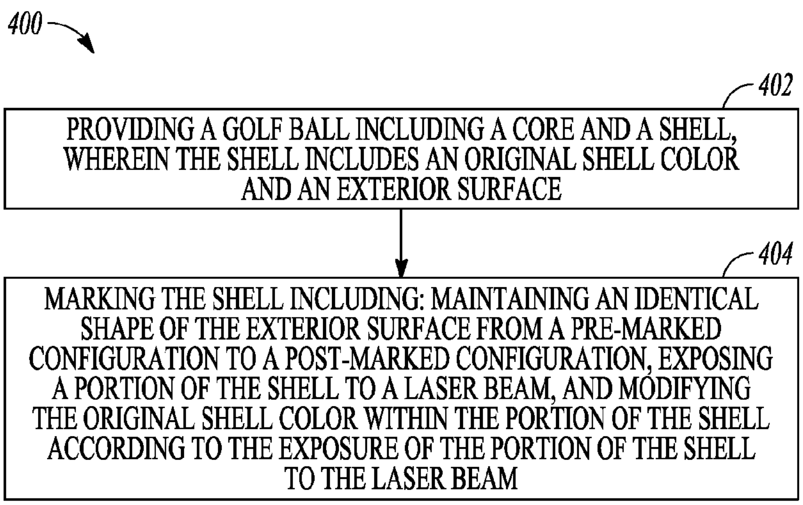

400
402
PROVIDING A GOLF BALL INCLUDING A CORE AND A SHELL, WHEREIN THE SHELL INCLUDES AN ORIGINAL SHELL COLOR AND AN EXTERIOR SURFACE
404
MARKING THE SHELL INCLUDING: MAINTAINING AN IDENTICAL SHAPE OF THE EXTERIOR SURFACE FROM A PRE-MARKED CONFIGURATION TO A POST-MARKED CONFIGURATION, EXPOSING A PORTION OF THE SHELL TO A LASER BEAM, AND MODIFYING THE ORIGINAL SHELL COLOR WITHIN THE PORTION OF THE SHELL ACCORDING TO THE EXPOSURE OF THE PORTION OF THE SHELL TO THE LASER BEAM

FIG. 4

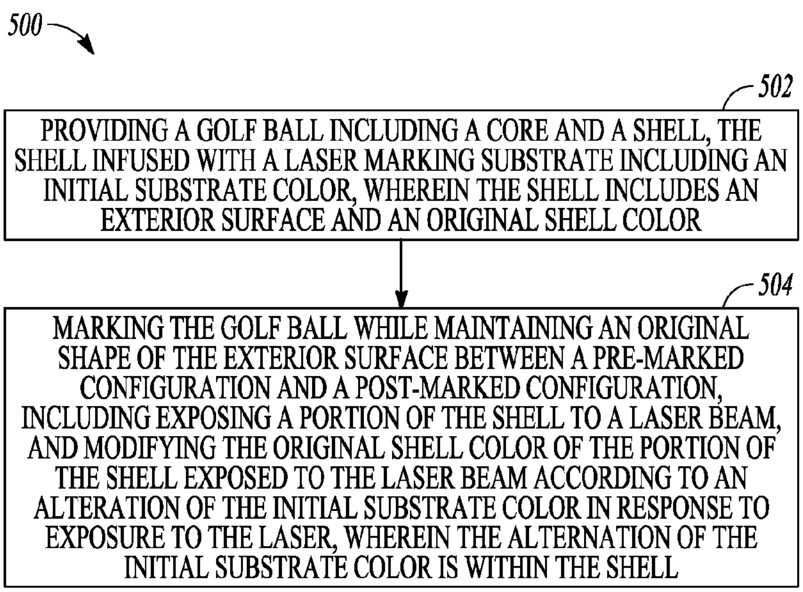

500
502
PROVIDING A GOLF BALL INCLUDING A CORE AND A SHELL, THE SHELL INFUSED WITH A LASER MARKING SUBSTRATE INCLUDING AN INITIAL SUBSTRATE COLOR, WHEREIN THE SHELL INCLUDES AN EXTERIOR SURFACE AND AN ORIGINAL SHELL COLOR
504
MARKING THE GOLF BALL WHILE MAINTAINING AN ORIGINAL SHAPE OF THE EXTERIOR SURFACE BETWEEN A PRE-MARKED CONFIGURATION AND A POST-MARKED CONFIGURATION, INCLUDING EXPOSING A PORTION OF THE SHELL TO A LASER BEAM, AND MODIFYING THE ORIGINAL SHELL COLOR OF THE PORTION OF THE SHELL EXPOSED TO THE LASER BEAM ACCORDING TO AN ALTERATION OF THE INITIAL SUBSTRATE COLOR IN RESPONSE TO EXPOSURE TO THE LASER, WHEREIN THE ALTERNATION OF THE INITIAL SUBSTRATE COLOR IS WITHIN THE SHELL

FIG. 5

APPARATUS AND METHOD FOR LASER MARKING GOLF BALLS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit and priority of U.S. Provisional Patent Application Ser. No. 61/917,214, filed Dec. 17, 2013, which is incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] Various embodiments described herein relate to systems and methods associated with laser marking of golf balls.

BACKGROUND INFORMATION

[0003] In the game of golf, golfers need to be able to distinguish their balls from other's to ensure the wrong ball is not played. Golf ball manufacturing generally applies identification to the balls including a number or other unique identifier for player identification on the golf course and one or more of brand identification or company logo information of the seller. In other instances, the balls may be identified with additional alphanumeric characters, artwork, alignment marks or customized information according to the end user or marketer. For example, standard golf balls are purchased at a sporting goods store and these same or similar balls are purchased with personalized or unique identifiers from custom golf ball printers. The objective of the end user is to obtain a golf ball that is properly identifiable and has good physical characteristics such as aerodynamics and roundness that will allow the ball to play well on the golf course.

[0004] In one example, the vast majority of golf balls produced have an internal core, may or may not have one or more intermediary layers and have a white outer shell. Most golf balls also have dimples on the outer surface of the outer shell. The dimple design allows the balls to travel further and straighter. The dimples facilitate the boundary layer of air next to the outer surface of the ball to transition from laminar to turbulent flow during flight. The turbulent air flow is able to remain attached (e.g., not separated) to the surface of the ball further along the outer surface of the ball, which reduces the low pressure zone in the slipstream of the golf ball, and thus reduces drag. This reduction in drag allows the ball to travel further. A smooth, clean surface, including dimples, can optimize the aerodynamics of the golf ball.

[0005] The vast majority of golf balls are identified and imprinted with ink by a process commonly known as pad printing. Pad or ink printing adds a layer of ink to the outer shell of a golf ball, for example in the form of shapes, letters or numbers. Another method of imprinting golf balls may include screen printing also known as silk-screening, which adds ink to the outer shell of the ball.

[0006] In one example, another method of marking golf balls may be to remove or etch the material of the cover of the golf ball with a laser. U.S. Pat. No. 6,462,303 shows one example of such an ablative method. In the U.S. Pat. No. 6,462,303 the surface material is physically removed, or ablated, from the golf ball cover, leaving an image engraved or machined within the cover layer. Optionally, Covers machined (e.g., ablated) using this process may be coated with one or more layers of opaque paint, and may be further sealed, as necessary or desired, with one or more transparent layers. For example, the deformed surface material of the golf ball cover is then filled in later with a suitable material.

Overview

[0007] The present inventor has recognized, among other things, that a problem to be solved can include minimizing the alteration of properties of a golf ball through marking of the golf ball. Marking including the ablation (removal) of material or printing (addition) of material each affect the properties of a golf ball including weight distribution, aerodynamic properties and the like.

[0008] In one example, added volume (e.g., ink mass) on the outer surface of the golf ball disrupts the dimpled pattern of the golf ball and the airflow over the golf ball surface resulting in adverse aerodynamic effects. Additionally, golf balls marked with ink commonly lose or partially lose ink from wear caused by striking the ball with the club head, repeated washings and the like. Worn golf balls in some instances become difficult to identify. Additionally, the process of refilling the removed material without disrupting the dimple pattern of the golf ball shell's outer surface is in some examples time consuming and costly. Further, in one or more examples, the material that replaces the ablated material should be bonded to the existing material and have similar mass, density, hardness, durability, and compression characteristics to minimize impact the physical properties of the golf ball. The supplementing of the golf ball surface (at the ablated portion) is in at least some examples a multiple step process that may introduce production error at one or more of the steps. Such error may adversely affect the aerodynamic shape and material properties of the outer surface of the ball.

[0009] The subject matter described herein provides a solution to these problems through laser marking of a golf ball without adding to (e.g., ink) or removing material from the surface (e.g., ablating) or altering the shape of the golf ball or its weight distribution. The aerodynamic properties and weight distribution of the laser marked golf ball is thereby maintained. Additionally, the subject matter described herein provides the further advantage of marking a golf ball, wherein the marking remains visible after the surface of the golf ball is abraded (e.g., through one or more strikes from clubs).

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The disclosure is pointed out with particularity in the appended claims. However, a more complete understanding of the present disclosure may be derived by referring to the detailed description when considered in connection with the figures, wherein like reference numbers refer to similar items throughout the figures and:

[0011] FIG. **1** is a side view of a golf ball with dimples, and a depiction of the focusing characteristics of a laser beam on the exterior surface of the golf ball, according to an example embodiment of the disclosure.

[0012] FIG. **2** is a cross section view of the outer layers of a golf ball including a laser marking substrate infused within a shell of the golf ball, according to an example embodiment of the disclosure.

[0013] FIG. **3** is a schematic view of one example of a laser marking system and a terminal station and power supply used in laser marking of a golf ball in accordance with an embodiment of the disclosure.

[0014] FIG. **4** is a block diagram of one example of marking a golf ball in accordance with an embodiment of the disclosure.

[0015] FIG. **5** is a block diagram of one example of marking a golf ball including a laser marking substrate in accordance with an embodiment of the disclosure.

DETAILED DESCRIPTION

[0016] The present application relates to devices and methods for marking a golf ball, such as laser marking a golf ball. The following detailed description includes examples intended to be illustrative of the subject matter disclosed herein and are in no way intended to be limiting. Features and steps described in relation to one or more examples may be combined with the subject matter of other examples and methods provided in this disclosure.

[0017] FIG. **1** is a side view of a golf ball **100**, such as a golf ball **100** with a shell **220** including an exterior surface **110**. For instance, the exterior surface **110** is the outer most surface of the shell **220**. In the example shown, the exterior surface **110** includes dimples **120**. The dimples **120** enhance the aerodynamic performance of the golf ball **100**. The shell **220** includes a shell material. The shell **220** and the shell material include an original shell color, and the exterior surface **110** of the shell **220** includes an original shape (e.g., a spherical shape with dimples **120**). The original color includes, but is not limited to white, off-white, yellow, orange, pink, or the like. In addition, FIG. **1** shows a depiction of a target region **130** of a laser beam on the exterior surface **110** of the golf ball **100**, according to an example embodiment of the disclosure.

[0018] In the example of FIG. **1**, the golf ball **100** includes a laser mark **140**, such as a laser mark **140** within the shell **220** of the golf ball **100** (i.e., a marked portion of the shell **220**). In one example, the shell **220** includes a pre-marked configuration and a post-marked configuration. For instance, in the pre-marked configuration, the shell **220** includes the original color, and in the post-marked configuration a portion (the laser marked portion) of the shell **220** includes a modified shell color. For instance, the modified shell color is a shell color that provides a contrast to the original shell color. The modified shell color results from exposure of the portion of the shell **220** to the laser beam. The modified color includes, but is not limited to, a darker shade of the original color, grey, black, or the like. In one example, the modified color includes a lighter color than the original color, such as a lighter shade of the original color, white, or the like. Stated another way, the modified color contrast with the original color. In the pre-marked configuration, the shape of the exterior surface **110** includes the original shape and the un-marked portion of the shell material includes the original shell color. In the post-marked configuration, a marked portion of the shell **220** includes a modified shell color, and the original shape of the exterior surface **110** is maintained from the pre-marked configuration (e.g., in the post-marked configuration, the shell **220** is identical to the pre-marked configuration). For instance, the exterior surface **110** of the golf ball **100** in the post-marked configuration includes a spherical shape with a dimple pattern that is identical to the original shape (e.g., spherical shape with the dimple pattern) of the exterior surface **110** in the pre-marked configuration. That is to say, material is neither added in the manner of printed labels nor removed in the manner of an ablation system.

[0019] In one example, the laser mark **140** is produced by exposing a portion of the shell **220** (FIG. **2**) to the laser beam. For instance, the laser beam is focused (e.g., at a focal point) on the portion of the shell **220** to be marked. The laser beam correspondingly modifies the original shell color, thereby marking the portion of the shell **220** with a modified shell color and forming the laser mark **140** shown in FIG. **1**. The laser is produced by a laser marking system (as shown in FIG. **3** and described herein). An exemplary target region **130**, such as an optimal target region for the laser beam of the laser marking system is provided on the exterior surface **110** of the golf ball **100** as shown in FIG. **1**.

[0020] In the example shown in FIG. **1**, marking is desired at and within the target region **130**. The target region **130** is the area that is effectively marked with a laser system, for instance, without moving or rotating the golf ball **100**. In the example shown, the shell **220** includes a laser mark **140** within the target region **130**. The target region **130** includes the surface area of the golf ball **100** at or between a top dead center A of the golf ball **100** and a target region limit B. In one example, some laser systems include a mechanism (focusing systems, translation of the laser or the like) to maintain the focal point while laser marking throughout the target region **130**.

[0021] FIG. **2** is a cross sectional depiction of the shell **220** (i.e., cover) and core **210** (e.g., a mantle) of a golf ball **100**. The golf ball **100** includes, but is not limited to, a solid core, liquid core, wound core, or any combination thereof. The core **210** includes a core material that includes, but is not limited to ethylene copolymers, balata, acrylate, natural rubber or synthetic rubber, such as polybutadiene rubber, a liquid core material, or the like. In one example, the golf ball **100** includes one or more cores **210**, such as two (e.g., three-piece ball) or three cores **210** (e.g., four-piece ball). The shell **220** of the golf ball **100** includes, but is not limited to, a copolymer, polyurethane, urethane, ionomer, or similar polymer.

[0022] In the example of FIG. **2**, the shell **220** includes a laser marking substrate **222** (shown as stippling). The laser marking substrate **222** includes, but is not limited to, titanium dioxide (e.g., powder), zinc oxide, zinc sulfide, or the like. The laser marking substrate **222** is infused (e.g., added or mixed) into the shell material before the shell **220** is applied (molded) to the golf ball **100**. In one example, the shell material includes one- to four-percent (e.g., by volume or weight depending upon the shell material) of the laser marking substrate **222**. For instance, the laser marking substrate **222** is mixed with the shell material in a mixing section of a barrel of an extruder or injection molding machine or within a hopper upstream from the extruder or injection molding machine. In one example, the laser marking substrate **222** includes an initial color. The initial color includes, but is not limited to the same color as the original color of the shell or another color.

[0023] The laser marking substrate **222** produces an altered substrate color in response to exposure to the laser beam (as further described with regard to FIG. **5**). The altered substrate color correspondingly modifies the original shell color (e.g., contrasting to the original color). The altered color produced by exposing the laser marking substrate **222** to the laser beam is dependent on the laser system parameters used to generate the laser beam (e.g., the power, scan rate, pulse frequency and pulse width) and the material of the laser marking substrate **222** (e.g., titanium dioxide, zinc oxide, zinc sulfide). The original shape of the exterior surface **110** is maintained from the pre-marked configuration to the post-marked configuration. For instance, no material is added or removed during the marking process. The original shape and characteristics of the golf ball **100** are maintained without the removal of material (ablating) or addition of material (printing).

[0024] To achieve a consistent laser mark **140** (e.g., a substantially uniform color and contrast), the laser marking substrate **222** is uniformly mixed into the shell material prior to forming the shell **220**. In other words, the laser marking substrate **222** is evenly (e.g., uniformly) dispersed into the shell material and the uniform distribution of the laser marking substrate **222** in the shell material (e.g., surrounding the core **210**) is maintained from the pre-marked configuration to the post-marked configuration. In one example, the laser mark **140** includes the modified shell color at a depth of about 0.004 inches or less from the exterior surface **110** of the shell **220** (within the shell as opposed to over the surface of the shell).

[0025] In one example, the golf ball **100** includes a clear coat. The clear coat is layered over the exterior surface **110** of the shell **220**. The clear coat includes, but is not limited to, a urethane, polyurethane, or other clear coat resin. In one example, the clear coat does not include the laser marking substrate **222**. In one example, the clear coat does not include a laser mark **140**. For instance, the clear coat is applied after the golf ball **100** is laser marked so the clear coat does not interfere with the laser marking process. In another example, the laser used with the laser marking process readily passes through the clear coat (it is transparent to the laser) to modify the shell **220** and the laser marking substrate **222** as described herein (i.e., the clear coat is applied prior to the laser marking).

[0026] In one particular example, the golf ball **100** includes the shell **220** constructed with, but not limited to, polyurethane, Surlyn or ionomer. The shell **220** includes titanium dioxide as the laser marking substrate **222**. The core **210** includes a polybutadiene rubber core. The laser marking system (as shown in FIG. **3** and described herein) produces a laser beam to mark the shell **220** (having a combination of materials as described above). The laser marking system includes laser system parameters that are controlled by the data input to the laser system. The laser system parameters include, but are not limited to, a 355 nm wavelength operating at 20 kHz, a 35 inch per second beam travel rate, a 5 μs (microsecond) pulse width, and an output power of around 1 Watt.

[0027] FIG. **3** is a schematic representation of one example of a laser marking system **301** used to laser mark a golf ball **100** according to the methods described herein. The laser marking system **301** includes two sections, for instance a workstation **300** and a terminal **310** connected with an umbilical assembly **320**. In this example the laser head **338** includes a laser resonator that generates the laser beam. The laser head **338** further houses a reflective rear mirror and a partially reflective front mirror (or output coupler). In another example, the laser resonator is included in the umbilical assembly **320**. In such a configuration the laser head **338** is eliminated.

[0028] The laser beam **331** used in marking the golf ball **100** is generated with electrical power from the power supply **350**. The power supply excites an active medium in the laser head **338**, and the laser head **338** discharges a laser beam to an X-Y galvanometer motor/mirror system **336**. The X-Y galvanometer mirror system **336** is controlled with motion control methods (e.g., software algorithms) from the terminal **354** according to data input from an input device, such as a keyboard **352** or from a motion algorithm provided by the terminal (e.g., a set pattern of laser movement for a desired logo, text or the like). The laser beam travels from the laser head **338**, into the X-Y galvanometer mirror system **336** and is steered downward 90 degrees from its original path through a focusing lens **333**.

[0029] The focusing lens **333** focuses the laser beam at a focal point (e.g., according to the focusing lens power). Laser marking of materials (e.g., a golf ball **100** including a laser marking substrate **222**) is generally done at or near the focal point of the laser beam **331** (e.g., a focused laser beam diameter) to ensure the target (e.g., the golf ball **100**) receives sufficient laser beam power density to mark the target (e.g., with clean well defined marking).

[0030] As shown in FIG. **3**, the golf ball **100** is positioned under the laser beam **331** with a fixture **332**. The fixture includes, but is not limited to, a single load fixture, a fully automated ball feeding fixture interfaced with the laser software and terminal **354** for high volume mass production or the like. The fixture **332** varies according to production volume (e.g., the fixture **332** is optionally configured to hold a plurality of balls). The golf ball fixture **332** is supported by a base **334**. Optionally, the base **334** is tied to the laser Z axis actuator **342** and support beam **340** (as described herein an optional supporting plate system for movement relative to the Z axis actuator **342**).

[0031] In one example, of the automated ball feeding fixture includes a feeder bowl (e.g., a hopper). For instance, a large number of golf balls **100** are continuously dispensed from a hopper (optional) and enter the feeder bowl (another hopper). The feeder bowl is arranged to dispense the golf balls **100** in single-file along a track that transports the golf balls **100** to the fixture **332**. Optionally, the automated ball feeding fixture includes a vibrating feeder bowl, track, or combination of both to move the golf balls **100** from the feeder bowl along the track and to the fixture **332**. In some instances, the vibrating feeder bowl or track minimizes jamming or clogging of the golf balls **100** along the path from the feeder bowl to the fixture **332**.

[0032] In another example, the fixture **332** includes a series of positioning members including, but not limited to rotating feet, rings, belts, pads, suction pads or the like, that coordinate to rotate and position the golf ball **100** for laser marking. In one example, the fixture **332** is in communication with the terminal **354** and operated in concert with the remainder of the laser marking system **301**. For example, the golf ball **100** is gradually rotated according to the pattern of markings input to the terminal. The fixture **332** rotates and positions each locus of a marking at the focal point of the laser beam **331**. Stated another way, the fixture **332** coordinates its movement with the scribing of the laser beam to gradually reposition and rotate the golf ball **100** without requiring manual interaction (hand positioning) by an operator or robotic arm system. The laser mark **140** is thereby provided to the golf ball **100** in an automated fashion according to movable positioning provided by the fixture **332**. Optionally, the positioning members (feet, rings, pads or the like) are indexed with graduated markings and an encoder and sensing system is configured to measure rotation and position of the positioning members and the terminal **354** corresponds these measurements with the position of the golf ball **100**. In still another example, an optical recognition sensor is directed at the golf ball **100** to measure the position of the golf ball **100** during rotation provided by the fixture, and feedback from the system is used to adjust the position of the golf ball.

[0033] In still another example, the fixture **332** includes two or more orifices for access to the golf ball **100**. For instance, the fixture **332** includes opposed orifices or openings that facilitate access to opposed ends of the golf ball **100**. Similarly, in such an example, the laser marking system **301** includes a second laser head (like head **338**) that generates a second laser beam **331** for marking of another portion of the golf ball **100**. For instance, in one example, the first and second laser heads **338** scribe the same or different markings on the golf ball **100** at positions around the golf ball **100** according to the fixture **332** and the position of the laser heads **338**. In still another example, alignment lines are provided along the circumference of the golf ball **100** (e.g., between markings provided by the laser heads **338**). In such an example, an optional third laser head **338** is provided to mark the alignment lines around the golf ball **100**. By providing multiple laser heads **338** movable positioning of the golf ball **100** is optionally avoided. Accordingly, upon installation of a golf ball **100** within the fixture **332** the multiple laser heads **338** mark the golf ball **100** at a plurality of locations in a simultaneous manner.

[0034] In another example, the workstation area **300** includes an automated Z axis actuator **342** controlled with the terminal **354** to raise and lower the laser head assembly **338** (as well as the galvanometer mirror system **336** and the focusing lens **333**). The workstation **300** ties the laser head assembly **338** to the automated Z axis actuator **342** as shown in FIG. **3** with a supporting plate system **340**. Optionally, the supporting plate system **340** uses a gusset support system. In still another example, the Z axis actuator **342** includes one or more actuators that move the laser components (head assembly **338**, mirror system **336** and the lens **333**) along one or more axes including, but not limited to, X, Y, Z and rotational and tilt axes.

[0035] In one example, the laser system includes an internal optical focusing element. The internal optical focusing element is configured to quickly move the focal point of the laser beam to focus closer or further from the exterior surface **110** of the shell **220**. For instance, the focus range of the internal optical focusing element includes, but is not limited to about one half inch or less. By programming the character and shape of the golf ball **100** (spherical with a set dimple pattern) into such a system, one or more of identifying or decorative characters and marks (e.g., the desired identification, pattern or art) are marked accurately and reliably on the golf ball **100** as the laser beam focal point travels away from top dead center A of the golf ball **100** and towards the target region limit B. For instance the laser system uses progressive programming of the ball character and shape to compensate for the changing distance between the intended marking surface (e.g., exterior surface **110** of the golf ball **100**) and the laser head to determine corresponding optical offsets (e.g., laser focus height from the laser head **338** to the ball) taking into account the programmed marks and characters. In one example, the laser system (shown herein) focuses the laser beam at the focal point within the target region **130**, such as midway between the top dead center A and the target range limit B to ensure consistent marking across the area at or between the top dead center A and the target region limit B. In still another example, the internal optical focus element adjusts the laser focal point as the laser scribes across the varying relative height of the marking surface (e.g., over the dimpled exterior surface **110** from about the top dead center A to about the target region limit B). Stated another way, the laser includes a relatively higher focal point near the top dead center A and is gradually focused at a lower focal point nearer to the target region limit B as the laser scribes from the top dead center A to the target region limit B. Accordingly, the marking on the golf ball **100** maintains a consistent size and formatting (and accordingly does not have the appearance of contracting near the top dead center A of the ball and expanding nearer to the target region limit B). In another example, the focal point is maintained at a constant value to ensure variation in marking size (e.g., stylized text that is larger at either end of the text nearer to the target region limit B and smaller in its middle near to the top dead center A).

[0036] One example of the laser systems includes a series of lenses combined with an aspheric lens that is adjusted to the diameter of the intended object (e.g., of the golf ball **100**). With the laser system including an aspheric lens, no in-process lens correction (e.g., internal optical focusing element) is needed during marking. Stated another way, the aspheric lens includes a profile (e.g., that is not part a portion of a sphere or cylinder) that produces a laser focal point located at or near the exterior surface **110** of the golf ball **100** for the entire target region **130** from the top dead center A to the target region limit B.

[0037] In another example, the laser marking system marks the golf ball **100** without using the previously discussed focus distance correcting applications (e.g., progressive programming). The focal point is set for a point midway between the top dead center A and the target region limit B. Distortion of the mark is minimized when the laser is directed near the top dead center A or when directed near the target region limit B because the focal point is located between the top dead center A and the target region limit B.

[0038] As further shown in FIG. **3**, the terminal **310** includes the power supply assembly **350**, and the power supply assembly **350** houses the laser power supply (and electronics coupled with the terminal **354**). The terminal **354** is optionally associated with the power supply assembly **350**. The terminal **354** optionally includes a vacuum system for fumes and a cooling system for the power supply.

[0039] It will be appreciated that some of the components of the laser marking system **301** may be configured differently or omitted from the exemplary arrangement shown in FIG. **3**. For instance, the laser marking system **301** may vary according to differences in fixtures **332**, available manufacturing floor space, work environment and similar considerations. The umbilical assembly **320** is in one example a flexible hose and conduit that delivers the electrical power and instructions to the laser head **338** and allows electronic and optical communication between the power supply electronics, the terminal **354**, and the workstation **300**. In other examples, the laser marking system **301** is consolidated within a single unit or separated into individual components beyond those shown in FIG. **3**.

[0040] In describing the methods **400** and **500**, reference is made to one or more components, features, functions, and steps previously described herein. Where convenient, reference is made to the components, features, steps and the like with reference numerals. Reference numerals provided are exemplary and are nonexclusive. For instance, features, components, functions, steps, and the like described in the methods **400** and **500** include, but are not limited to, the corresponding numbered elements provided herein. Other corresponding features described herein (both numbered and unnumbered) as well as their equivalents are also considered.

[0041] FIG. **4** is a block diagram of an exemplary method for laser marking a golf ball **100**, wherein the original shell material of the golf ball **100** is non-white or non-off-white. In one example, the laser provides a subsurface mark, for instance by producing a modified color of the shell material that is lighter than the original shell material. For instance, with a dark colored shell **220** the laser may lighten (instead of darken) the shell **220** to mark the ball.

[0042] At **402**, the method **400** includes providing a golf ball **100** including the core **210** and the shell **220**, wherein the shell **220** includes an original shell color and an exterior surface **110**. The golf ball **100** includes, but is not limited to, a solid core, liquid core, wound core, or any combination thereof. In one example, the provided golf ball **100** includes a shell **220** including, but not limited to, a copolymer, polyurethane, urethane, ionomer, or similar polymer. The core **210** of the golf ball **100** includes a core material that includes, but is not limited to, ethylene copolymers, balata, acrylate, natural rubber or synthetic rubber, such as polybutadiene rubber, a liquid core material, or the like. In one example, the golf ball **100** includes one or more cores **210**, such as two (e.g., three-piece ball) or three cores **210** (e.g., four-piece ball). The shell **220** and the shell material include the original shell color, and the exterior surface **110** of the shell **220** includes the original shape (e.g., a spherical shape with dimples **120**). The original color includes, but is not limited to yellow, orange, pink, other non-white colors, or the like.

[0043] At **404**, the method includes marking the shell **220** including maintaining an identical shape of the exterior surface **110** (e.g., original shape) from a pre-marked configuration to a post-marked configuration, exposing a portion of the shell **220** to a laser beam, and modifying the original shell color within the portion of the shell **220** according to the exposure of the portion of the shell **220** to the laser beam. That is to say, the laser marking of the shell **220** occurs within the shell.

[0044] Maintaining the identical shape includes marking the golf ball **100** without ablating the exterior surface **110** of the golf ball **100**. For instance, the exterior surface **110** includes an original shape, such as a spherical original shape in the pre-marked configuration, and the golf ball **100** includes the original shape in the post-marked configuration (i.e., the golf ball **100** includes a laser mark **140**). In one example where the original shape of the golf ball **100** includes dimples **120** arranged in a pattern, the shape and pattern of the dimples **120** in the post-marked configuration includes the original shape and pattern of the dimples in the pre-marked configuration.

[0045] In one example, exposing the shell **220** to the laser beam includes focusing the laser beam, such as a laser beam produced by the laser system described herein, on the exterior surface **110** of the golf ball **100**. The laser beam is focused with enough power density to do the required work at the work piece (e.g., produce a laser mark **140** on the shell **220** of the golf ball **100**). The laser beam emitted from the laser system is focused by the focusing lens **333**. The focusing lens **333** is attached to a laser head assembly (as shown in FIG. **3** and previously described herein). In one example, the focal point of the laser will be the location at which the laser beam is at its smallest diameter along the path of travel from the laser head and through the focusing lens **333**. In one example, to produce a laser mark **140** in the shell **220** that accurately represents the intended mark, the focal point of the laser beam is located within the focus range of the intended target surface (e.g., the exterior surface **110** of the golf ball **100**). For instance, the focus range includes maintaining the location of the focal point to within +/−0.050 inches of the exterior surface **110**. In one example, the focal point is within the shell **220** of the golf ball **100** (i.e., a sub-surface laser marking).

[0046] In the example of method **400**, modifying the original shell color of the portion of the shell **220** exposed to the laser as a result of exposing a portion of the shell to the laser beam includes producing gas pockets in the shell **220**. The gas pockets are produced by exposing the shell **220** to the laser beam. For instance, the energy of the laser beam causes slight degradation (e.g., foaming) in the shell material resulting in the formation of the gas pockets. The gas pockets scatter light within the shell **220**, thereby producing laser marks **140** on the golf ball **100** that are lighter than the original shell color (a modified shell color). In one example, the original shell color is modified within the shell **220** at a depth of 0.004 inches or less from the exterior surface **110** of the shell **220**.

[0047] The laser marking system **301**, that produces the laser beam, includes laser system parameters that are controlled by the data input to the laser system **301**. The laser system parameters include, but are not limited to, a power of about 0.2 Watts to 3.0 Watts, a focal point (focused laser beam) diameter of 0.0006 to 0.005 inches, a pulse width from 0.1 μs (microseconds) to 30.0 μs, and a wavelength from 150 nm to 1064 nm. In one example, the laser beam is translated (e.g., scribed) along the exterior surface **110** of the golf ball **100** at a beam travel rate. The beam travel rate is the rate at which the mirror system **336** steers the focal point of the laser beam at the exterior surface **110**.

[0048] In one example, the laser system **301** generates a laser beam in a series of laser pulses. In other words, the laser beam is exposed to the exterior surface **110** in a non-continuous manner. The laser system **301** generates the laser pulses and includes laser system parameters to adjust the pulse width from 0.1 μs (microseconds) to 30.0 μs. The mark produced by each laser pulse touches, or nearly touches, the preceding mark. In one example, the surface area of the marks overlap one another by nearly 90%. In one example, the laser pulses translate along the exterior surface **110** at a scan rate of one inch per-second to one-hundred inches per-second. The overlap of the marks is dependent on the pulse width and the scan rate of the laser system parameters. For instance, when the laser system parameters include a constant pulse width, the area of the overlap of the marks is decreased as the scan rate (the beam travel rate along the exterior surface **110**) is increased. In one example, the contrast of the modified shell color is increased by adjusting one or more of the laser system parameters including, but not limited to, increasing the overlapping area of the marks, decreasing the pulse width, decreasing the scan rate, or increasing the power of the laser beam.

[0049] In one example, the laser beam is a continuous wave laser beam. For instance, the laser beam is continuously exposed to the golf ball **100** during laser marking. For instance the laser beam is not pulsed. The continuous wave laser beam produces a continuous laser mark on the golf ball **100**, so there is no spacing between the laser marks and the degree of overlap is not an issue. In one example, the scan rate of the laser controls the contrast of the modified shell color. For instance, a slow scan rate produces dark marks and a high scan rate produces light marks.

[0050] In one example, the method **400** further includes applying a clear coat over the exterior surface **110** of the shell **220**. The clear coat includes, but is not limited to, a urethane, polyurethane, or other clear coat resin known to one of ordinary skill in the art. In one example, the clear coat is applied after the golf ball **100** is laser marked so the clear coat does not interfere with the laser marking process. In another example, the laser used with the laser marking process readily passes through the clear coat to modify the shell **220** as a result of exposing a portion of the shell to the laser beam as described herein (i.e., the clear coat is applied prior to the laser marking).

[0051] FIG. **5** is a block diagram of an exemplary method **500** for laser marking a golf ball **100**, wherein the original shell material of the golf ball **100** is white, off-white, yellow, orange, pink, or the like. In one example, a laser mark **140** is produced on the golf ball **100** that includes a laser mark **140** with a modified color that is a darker color than the original shell color. For instance, the laser mark **140** includes a darker shade of the original shell color, grey, black, or the like.

[0052] At **502**. The method **500** includes providing a golf ball **100** including the core **210** and the shell **220**, the shell **220** infused with a laser marking substrate **222** including an initial substrate color, wherein the shell **220** includes an exterior surface **110** and an original shell color, as previously described herein.

[0053] At **504**, the method **500** further includes marking the golf ball **100** (e.g., with the laser system described herein) while maintaining an original shape of the exterior surface **110** between a pre-marked configuration and a post-marked configuration, including exposing a portion of the shell **220** to a laser beam, and modifying the original shell color of the portion of the shell **220** exposed to the laser beam according to an alteration of the initial substrate color in response to exposure to the laser, wherein the alternation of the initial substrate color is within the shell **220** (including on the exterior surface **110**).

[0054] The altered substrate color is produced in response to exposing the laser marking substrate **222** to the laser beam. The laser marking substrate **222** includes an altered substrate color that is darker than the initial substrate color as a result of exposure to the laser beam. The laser marking substrate **222** absorbs more light than the shell material and in response, becomes darker than the original substrate color. For instance, the darkening of the laser marking substrate **222** is caused by one or more of a chemical reaction, annealing, carbonization, or other photochemical reaction in the laser marking substrate **222**. In one example, chemical bonds between the laser marking substrate **222** and the shell material are broken causing the altered substrate color as a result of the exposure to the laser beam.

[0055] The altered substrate color correspondingly modifies the original shell color (e.g., contrasting to the original shell color). In one example, the laser marking includes the modified shell color at a depth of about 0.004 inches or less from the exterior surface **110** of the shell **220**. The uniform distribution and amount of the laser marking substrate **222** infused into the shell material affects the amount of corresponding modification of the original shell color. In one example, larger amounts of laser marking substrate **222** produce greater corresponding modification of the original shell color. The altered substrate color is also, for instance, dependent on the laser system parameters used to generate the laser beam (e.g., the power, scan rate, pulse frequency and pulse width) and the material of the laser marking substrate **222** (e.g., titanium dioxide, zinc oxide, or zinc sulfide). To achieve a consistent laser marking (e.g., a substantially uniform modified shell color and laser marking contrast), the laser marking substrate **222** is uniformly mixed into the shell material prior to forming the shell **220**. In other words, the laser marking substrate **222** is evenly (e.g., uniformly) dispersed into the shell material. Optionally, the power of the laser beam exposed to the laser marking substrate **222** is adjusted during the laser marking process to provide multiple marks. Each of the one or more marks optionally includes a different shading (or contrast) relative to the original shell color according to the power of the laser beam exposed to each of the laser marks **140**. In one example, the laser mark **140** is darker when the laser marking substrate **222** is exposed to a laser beam that includes a high power as opposed to a lighter laser mark **140** that is created when the laser marking substrate **222** is exposed to a laser beam including a low power.

[0056] The original shape of the exterior surface **110** is maintained from the pre-marked configuration to the post-marked configuration. For instance, no material is added or removed during the marking process. Stated another way, the original golf ball **100** maintains its desired shape and characteristics without the removal of material (ablating) or addition of material (printing). In one example, the uniform distribution of the laser marking substrate **222** in the shell material (e.g., surrounding the core **210**) is maintained from the pre-marked configuration to the post-marked configuration.

[0057] In one example, the method **500** further includes applying a clear coat over the exterior surface **110** of the shell **220**. The clear coat includes, but is not limited to, a urethane, polyurethane, or other clear coat resin known to one of ordinary skill in the art. In one example, the clear coat does not include the laser marking substrate **222**. In one example, the clear coat is applied after the golf ball **100** is laser marked so the clear coat does not interfere with the laser marking process. In another example, the laser used with the laser marking process readily passes through the clear coat to modify the shell **220** and the laser marking substrate **222** as described herein (i.e., the clear coat is applied prior to the laser marking).

[0058] The methods and systems described herein further allow for the laser marking of a golf ball **100** with the desired marking quickly changed in the laser software screen in a matter of seconds or minutes depending on what changes are made. In contrast, pad printing requires a new mold for each imprint (based on changes between an original imprint and a desired later imprint).

[0059] Further, as described herein the present methods and systems permanently embed the laser marking within the shell **220** (e.g., up to approximately 0.004 inches deep within the shell **220**). The laser marking will not ablate (short of destruction of the ball) because of striking by a club head or from normal wear over the lifetime of the golf ball **100**. In contrast, ink eventually flakes (ablate) from the shell **220** after repeated ball impacts or wear of the ball over time.

[0060] Further still, as described with the systems and methods herein the exterior surface **110** of the golf ball **100** is not ablated or printed on and is accordingly unaffected by material removal (ablation) or material addition (ink printing). Instead, the shell **220** as described herein is unaffected during the laser marking process (with corresponding laser system parameters) and the physical properties of the golf ball **100** are maintained. Such physical properties include the aerodynamic shape of the ball, the dimple patterns of the ball, the desired weight distribution of the shell **220** around the core **210**, or the like. For example, when a laser marked golf ball **100** is viewed under a microscope at 15× magnification there is no noticeable difference in the surface texture of the marked areas when compared with the surface texture of the non-marked areas.

[0061] Another advantage of the present method is that the forgiveness in the effective focus range of the method is suitable for marking the arc of the exterior surface **110** of the golf ball **100** and the dimple patterns of the ball (e.g., within the target region **130** shown in FIG. **1**) without inconsistencies provided with other marking methods that require physical contact between the ball and the imprinter. It is challenging to ink print a surface with dimples **120**, especially when the surface is also curved. The imprint pad in contact with the curved surface is matched to the surface. Pad printing on a curved surface may leave smears on the surface where the imprint pad has not properly conformed to the dimples **120** and curved surface. Laser marking addresses these challenges, as there is no physical contact between the surface and the laser head **338**.

Various Notes & Examples

[0062] Example 1 can include subject matter such as can include a method for laser marking a golf ball comprising: providing a golf ball including a core and a shell, the shell infused with a laser marking substrate including an initial substrate color, wherein the shell includes an exterior surface and an original shell color; marking the golf ball while maintaining an original shape of the exterior surface between a pre-marked configuration and a post-marked configuration, including: exposing a portion of the shell to a laser beam, and modifying the original shell color of the portion of the shell exposed to the laser beam according to an alteration of the initial substrate color in response to exposure to the laser, wherein the alternation of the initial substrate color is within the shell.

[0063] Example 2 can include, or can optionally be combined with the subject matter of Example 1 to optionally include wherein the laser marking substrate includes one or more of titanium dioxide, zinc oxide, or zinc sulfide.

[0064] Example 3 can include, or can optionally be combined with the subject matter of Examples 1 or 2 to optionally include wherein marking the shell includes modifying the original shell color at a depth of about 0.004 inches or less from the exterior surface.

[0065] Example 4 can include, or can optionally be combined with the subject matter of Examples 1-3 to optionally include wherein maintaining the original shape of the exterior surface includes maintaining a dimple pattern of the golf ball.

[0066] Example 5 can include, or can optionally be combined with the subject matter of Examples 1-4 to optionally include wherein maintaining the original shape of the exterior surface includes maintaining a spherical shape of the golf ball.

[0067] Example 6 can include, or can optionally be combined with the subject matter of Examples 1-5 to optionally include wherein marking the shell includes maintaining a uniform distribution of shell material around the core in the pre-marked configuration and the post-marked configuration.

[0068] Example 7 can include, or can optionally be combined with the subject matter of Examples 1-6 to optionally include applying a clear coat over the exterior surface of the shell, wherein the clear coat does not include laser marking substrate.

[0069] Example 8 can include, or can optionally be combined with the subject matter of Examples 1-7 to optionally include wherein the laser beam includes a power of 0.2 Watts to 3.0 Watts, a pulse width of 0.1 μs to 30.0 μs, and a wave length of 150 nm to 550 nm.

[0070] Example 9 can include, or can optionally be combined with the subject matter of Examples 1-8 to optionally include a laser marked golf ball comprising: a core; a shell surrounding the core, the shell including: a shell material, an exterior surface of the shell; one or more laser marks within the shell material wherein the golf ball includes: a pre-marked configuration, wherein a shape of the exterior surface includes an original shape, and an un-marked portion of the shell material includes an original shell color, and a post-marked configuration, wherein a marked portion of the shell includes a modified shell color, and the original shape of the exterior surface is maintained from the pre-marked configuration.

[0071] Example 10 can include, or can optionally be combined with the subject matter of Examples 1-9 to optionally include laser marking substrate infused within the shell material, the laser marking substrate including: a pre-marked configuration, wherein the laser marking substrate includes an initial substrate color, and a post-marked configuration, wherein the laser marking substrate includes an altered substrate color, the altered substrate color correspondingly modifying the original shell color.

[0072] Example 11 can include, or can optionally be combined with the subject matter of Examples 1-10 to optionally include wherein the laser marking substrate includes one or more of titanium dioxide, zinc oxide, or zinc sulfide.

[0073] Example 12 can include, or can optionally be combined with the subject matter of Examples 1-11 to optionally include wherein the one or more laser marks is located in the shell at a depth of about 0.004 inches or less from the exterior surface.

[0074] Example 13 can include, or can optionally be combined with the subject matter of Examples 1-12 to optionally include wherein the original shape of the exterior surface includes a spherical shape and a dimple pattern, and the spherical shape and the dimple pattern are identical between the pre-marked configuration and the post-marked configuration.

[0075] Example 14 can include, or can optionally be combined with the subject matter of Examples 1-13 to optionally include wherein the shell material is uniformly distributed around the core in the pre-marked configuration and the post-marked configuration.

[0076] Example 15 can include, or can optionally be combined with the subject matter of Examples 1-14 to optionally include wherein the shell material in the post-marked configuration is non-ablated with the one or more laser marks within the shell material.

[0077] Example 16 can include, or can optionally be combined with the subject matter of Examples 1-15 to optionally include a method of laser marking a golf ball comprising: providing a golf ball including a core and a shell, wherein the shell includes an original shell color and an exterior surface; marking the shell including: maintaining an identical shape of the exterior surface from a pre-marked configuration to a post-marked configuration, exposing a portion of the shell to a laser beam, and modifying the original shell color within the portion of the shell according to the exposure of the portion of the shell to the laser beam.

[0078] Example 17 can include, or can optionally be combined with the subject matter of Examples 1-16 to optionally include wherein modifying the original shell color includes producing gas pockets in the shell, the gas pockets resulting from exposure to the laser beam.

[0079] Example 18 can include, or can optionally be combined with the subject matter of Examples 1-17 to optionally include wherein providing the golf ball includes providing the shell including a shell material, wherein the shell material includes a laser marking substrate including one or more of titanium dioxide, zinc oxide, or zinc sulfide.

[0080] Example 19 can include, or can optionally be combined with the subject matter of Examples 1-18 to optionally include wherein marking the shell includes modifying the original shell color at a depth of about 0.004 inches or less from the exterior surface.

[0081] Example 20 can include, or can optionally be combined with the subject matter of Examples 1-19 to optionally include wherein maintaining the identical shape of the exterior surface includes maintaining a dimple pattern of the golf ball.

[0082] Example 21 can include, or can optionally be combined with the subject matter of Examples 1-20 to optionally include wherein maintaining the identical shape of the exterior surface includes maintaining a spherical shape of the golf ball.

[0083] Example 22 can include, or can optionally be combined with the subject matter of Examples 1-21 to optionally include wherein maintaining the identical shape of the exterior surface includes maintaining a uniform distribution of shell material around the core.

[0084] Example 23 can include, or can optionally be combined with the subject matter of Examples 1-22 to optionally include wherein the laser beam includes a power of 0.2 Watts to 3.0 Watts, a pulse width of 0.1 μs to 30.0 μs, and a wave length of 150 nm to 550 nm.

[0085] Each of these non-limiting examples can stand on its own, or can be combined in various permutations or combinations with one or more of the other examples.

[0086] The above detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the invention can be practiced. These embodiments are also referred to herein as "examples." Such examples can include elements in addition to those shown or described. However, the present inventors also contemplate examples in which only those elements shown or described are provided. Moreover, the present inventors also contemplate examples using any combination or permutation of those elements shown or described (or one or more aspects thereof), either with respect to a particular example (or one or more aspects thereof), or with respect to other examples (or one or more aspects thereof) shown or described herein.

[0087] In the event of inconsistent usages between this document and any documents so incorporated by reference, the usage in this document controls.

[0088] In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one, independent of any other instances or usages of "at least one" or "one or more." In this document, the term "or" is used to refer to a nonexclusive or, such that "A or B" includes "A but not B," "B but not A," and "A and B," unless otherwise indicated. In this document, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, composition, formulation, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

[0089] Method examples described herein can be machine or computer-implemented at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer readable instructions for performing various methods. The code may form portions of computer program products. Further, in an example, the code can be tangibly stored on one or more volatile, non-transitory, or non-volatile tangible computer-readable media, such as during execution or at other times. Examples of these tangible computer-readable media can include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAMs), read only memories (ROMs), and the like.

[0090] The above description is intended to be illustrative, and not restrictive. For example, the above-described examples (or one or more aspects thereof) may be used in combination with each other. Other embodiments can be used, such as by one of ordinary skill in the art upon reviewing the above description. The Abstract is provided to comply with 37 C.F.R. §1.72(b), to allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. Also, in the above Detailed Description, various features may be grouped together to streamline the disclosure. This should not be interpreted as intending that an unclaimed disclosed feature is essential to any claim. Rather, inventive subject matter may lie in less than all features of a particular disclosed embodiment. Thus, the following claims are hereby incorporated into the Detailed Description as examples or embodiments, with each claim standing on its own as a separate embodiment, and it is contemplated that such embodiments can be combined with each other in various combinations or permutations. The scope of the invention should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

What is claimed is:

1. A method for laser marking a golf ball comprising:

providing a golf ball including a core and a shell, the shell infused with a laser marking substrate including an initial substrate color, wherein the shell includes an exterior surface and an original shell color;

marking the golf ball while maintaining an original shape of the exterior surface between a pre-marked configuration and a post-marked configuration, including:

exposing a portion of the shell to a laser beam, and

modifying the original shell color of the portion of the shell exposed to the laser beam according to an alteration of the initial substrate color in response to exposure to the laser, wherein the alternation of the initial substrate color is within the shell.

2. The method of claim **1**, wherein the laser marking substrate includes one or more of titanium dioxide, zinc oxide, or zinc sulfide.

3. The method of claim **1**, wherein marking the shell includes modifying the original shell color at a depth of about 0.004 inches or less from the exterior surface.

4. The method of claim **1**, wherein maintaining the original shape of the exterior surface includes maintaining a dimple pattern of the golf ball.

5. The method of claim **1**, wherein maintaining the original shape of the exterior surface includes maintaining a spherical shape of the golf ball.

6. The method of claim **1**, wherein marking the shell includes maintaining a uniform distribution of shell material around the core in the pre-marked configuration and the post-marked configuration.

7. The method of claim **1**, further comprising applying a clear coat over the exterior surface of the shell, wherein the clear coat does not include laser marking substrate.

8. The method of claim **1**, wherein the laser beam includes a power of 0.2 Watts to 3.0 Watts, a pulse width of 0.1 μs to 30.0 μs, and a wave length of 150 nm to 550 nm.

9. A laser marked golf ball comprising:

a core;

a shell surrounding the core, the shell including:

a shell material,

an exterior surface of the shell;

one or more laser marks within the shell material wherein the golf ball includes:

a pre-marked configuration, wherein a shape of the exterior surface includes an original shape, and an unmarked portion of the shell material includes an original shell color, and

a post-marked configuration, wherein a marked portion of the shell includes a modified shell color, and the original shape of the exterior surface is maintained from the pre-marked configuration.

10. The laser marked golf ball of claim **9**, further comprising laser marking substrate infused within the shell material, the laser marking substrate including:

a pre-marked configuration, wherein the laser marking substrate includes an initial substrate color, and

a post-marked configuration, wherein the laser marking substrate includes an altered substrate color, the altered substrate color correspondingly modifying the original shell color.

11. The laser marked golf ball of claim **10**, wherein the laser marking substrate includes one or more of titanium dioxide, zinc oxide, or zinc sulfide.

12. The laser marked golf ball of claim **9**, wherein the one or more laser marks is located in the shell at a depth of about 0.004 inches or less from the exterior surface.

13. The laser marked golf ball of claim **9**, wherein the original shape of the exterior surface includes a spherical shape and a dimple pattern, and the spherical shape and the dimple pattern are identical between the pre-marked configuration and the post-marked configuration.

14. The laser marked golf ball of claim **9**, wherein the shell material is uniformly distributed around the core in the pre-marked configuration and the post-marked configuration.

15. The laser marked golf ball of claim **9**, wherein the shell material in the post-marked configuration is non-ablated with the one or more laser marks within the shell material.

16. A method of laser marking a golf ball comprising:

providing a golf ball including a core and a shell, wherein the shell includes an original shell color and an exterior surface;

marking the shell including:

maintaining an identical shape of the exterior surface from a pre-marked configuration to a post-marked configuration,

exposing a portion of the shell to a laser beam, and

modifying the original shell color within the portion of the shell according to the exposure of the portion of the shell to the laser beam.

17. The method of claim **16**, wherein modifying the original shell color includes producing gas pockets in the shell, the gas pockets resulting from exposure to the laser beam.

18. The method of claim **16**, wherein providing the golf ball includes providing the shell including a shell material, wherein the shell material includes a laser marking substrate including one or more of titanium dioxide, zinc oxide, or zinc sulfide.

19. The method of claim **16**, wherein marking the shell includes modifying the original shell color at a depth of about 0.004 inches or less from the exterior surface.

20. The method of claim **16**, wherein maintaining the identical shape of the exterior surface includes maintaining a dimple pattern of the golf ball.

21. The method of claim **16**, wherein maintaining the identical shape of the exterior surface includes maintaining a spherical shape of the golf ball.

22. The method of claim **16**, wherein maintaining the identical shape of the exterior surface includes maintaining a uniform distribution of shell material around the core.

23. The method of claim **16**, wherein the laser beam includes a power of 0.2 Watts to 3.0 Watts, a pulse width of 0.1 μs to 30.0 μs, and a wave length of 150 nm to 550 nm.

* * * * *