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Watch Part And Watch

Abstract

A watch part includes a base material having a watch part shape and containing silicon as a primary component and a light-reflecting layer stacked on the base material, wherein the light-reflecting layer includes a first layer, a second layer, and a third layer which are successively stacked in this order from the base material, the first layer is formed using silicon oxide, the second layer is formed using silicon, and the third layer is formed using a material having a refractive index of 1.7 to 2.7.

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Background/Summary

[0001] The present application is based on, and claims priority from JP Application Serial Number 2024-024390, filed Feb. 21, 2024, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a watch part and a watch.

2. Related Art

[0003] JP-A-2020-148651 discloses that a light-reflecting layer having a three-layer structure in which a first silicon oxide layer, a silicon layer, and a second silicon oxide layer are stacked in this order is disposed on a base material containing silicon as a primary component.

[0004] According to JP-A-2020-148651, since three layers composed of the silicon oxide layer serving as a relatively-low refractive index layer and the silicon layer serving as a relatively-high refractive index layer which are alternately stacked on the silicon base material, decoration can be performed with favorable color developability compared with the instance in which a single silicon oxide layer is stacked on the base material.

[0005] In JP-A-2020-148651, the third layer is formed using silicon oxide. In such an instance, there is a problem that it is difficult to realize quiet, deep color development since the brightness is increased by merely changing the layer thickness of the third layer.

SUMMARY

[0006] According to an aspect of the present disclosure, a watch part includes a base material having a watch part shape and containing silicon as a primary component and a light-reflecting layer stacked on the base material, wherein the light-reflecting layer includes a first layer, a second layer, and a third layer which are successively stacked in this order from the base material, the first layer is formed using silicon oxide, the second layer is formed using silicon, and the third layer is formed using a material having a refractive index of 1.7 to 2.7.

[0007] According to an aspect of the present disclosure, a watch includes the above-described watch part.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is an elevation view illustrating a watch according to an embodiment when viewed from a dial side.

[0009] FIG. **2** is a diagram illustrating the watch according to the embodiment when viewed from a case back side.

[0010] FIG. **3** is a plan view illustrating an escape wheel and pinion portion according to the embodiment.

[0011] FIG. **4** is a partial sectional view of the escape wheel and pinion portion according to the embodiment.

[0012] FIG. **5** is a model diagram illustrating the light reflection by a light-reflecting layer.

[0013] FIG. **6** is a flow sheet illustrating a producing method of the escape wheel and pinion according to the embodiment.

DESCRIPTION OF EMBODIMENTS

Embodiments

[0014] A watch **1** according to an embodiment of the present disclosure will be described below with reference to the drawings.

[0015] FIG. **1** is an elevation view illustrating the watch **1**, and FIG. **2** is a diagram illustrating the watch **1** when viewed from a case back side. In the present embodiment, the watch **1** is configured to be a mechanical wristwatch that is put on a wrist of a user. In this regard, the watch **1** has a seethrough structure in which a portion of a movement **40** can be perceived from the dial **3** side and the case back **35** side.

[0016] As illustrated in FIG. **1** and FIG. **2**, the watch **1** includes a cylindrical outer case **5**, and a disc-like dial **3** is disposed on the inner circumferential side of the outer case **5**. The dial **3** is provided with a window **48**A. The watch **1** has a configuration in which a portion of the movement **40** is perceived through the window **48**A.

[0017] Of two openings of the outer case **5**, a surface-side opening is closed by a cover glass **6** having translucency, and a back-surface-side opening is provided with the case back **35**.

[0018] In this regard, the watch **1** includes the movement **40** housed in the outer case **5**, an hour hand **44**A and a minute hand **44**B which indicate time information, a power reserve hand **44**C which indicates the duration due to a mainspring, and a small seconds hand **44**D.

[0019] The hour hand **44**A, the minute hand **44**B, the power reserve hand **44**C, and the small seconds hand **44**D are attached to an indicator hand shaft of the movement **40** and driven by the movement **40**.

[0020] A crown **7** is disposed on the side surface of the outer case **5**. When the crown **7** is operated, an input corresponding to the operation can be performed.

[0021] Further, in FIG. **1**, an escape wheel and pinion **101**, a pallet fork **28**, a balance wheel **27**, a hairspring **29**, and the like which constitute a portion of the movement **40** can be perceived through the window **48**A disposed in the dial **3** when viewed from the dial **3** side.

[0022] In addition, the escape wheel and pinion **101** includes the escape wheel and pinion portion **100** and a shaft member **102**. In this regard, the escape wheel and pinion portion **100** is an example of the watch part according to the present disclosure.

[0023] The case back **35** is composed of a ring-like frame member **46** which forms an outer circumferential portion and the window **48**B formed from a transparent member fit into the frame member **46**.

[0024] The movement **40** includes a train wheel **45**, a balance bridge **13**, a manual winding mechanism **60**, an automatic winding mechanism **50**, and the like.

[0025] The train wheel **45** includes a movement barrel complete **21**, a center wheel and pinion, a third wheel and pinion, a fourth wheel and pinion **51**, the escape wheel and pinion **101**, the pallet fork **28**, the balance wheel **27**, and the like which are disposed on the case back side of a main plate. FIG. **2** illustrates the movement barrel complete **21**, the fourth wheel and pinion **51**, the escape wheel and pinion **101**, the pallet fork **28**, and the balance wheel **27**. The escape wheel and pinion **101** and the pallet fork **28** constitute an escapement **80**, and the balance wheel **27** and the hairspring **29** constitute a speed governor **70**.

[0026] The manual winding mechanism **60** includes a setting stem, a winding pinion, a clutch wheel, a crown wheel **61**, an intermediate ratchet wheel **62**, a ratchet wheel **63**, and the like. FIG. **2** illustrates the crown wheel **61**, the intermediate ratchet wheel **62**, and the ratchet wheel **63**.

[0027] The automatic winding mechanism **50** includes an oscillating weight, a bearing, an eccentric wheel, a pawl lever, a transmission wheel **52**, and the like. FIG. **2** illustrates the transmission wheel **52**.

[0028] In FIG. **2**, the movement barrel complete **21**, the escape wheel and pinion **101**, the pallet fork **28**, the balance wheel **27**, the crown wheel **61**, the intermediate ratchet wheel **62**, the ratchet wheel **63**, the eccentric wheel, the transmission wheel **52**, and the like which constitute a portion of the movement **40** can be perceived from the case back **35** side through the window **48**B disposed in the case back **35**.

[0029] As described above, in the present embodiment, since the escape wheel and pinion portion **100** of the escape wheel and pinion **101** can be perceived through the window **48**A of the dial **3** and the cover glass **6**, the design flexibility of the watch **1** can be enhanced. Further, since the escape wheel and pinion portion **100** of the escape wheel and pinion **101** can be perceived from the case back **35** side through the window **48**B disposed in the case back **35**, the design flexibility of the

watch **1** can be enhanced.
[0030] In this regard, in the watch **1**, an aspect in which the constituent part of the movement **40** is perceived from the dial **3** side or the case back **35** side is not limited to the above-described aspect.
[0031] For example, a predetermined constituent part of the movement **40** may be made perceivable by appropriately changing the design, the size, the arrangement position, the number of windows, and the like of the windows **48**A and **48**B.
[0032] In addition, the entire dial **3** may be formed of a transparent material, and the entire movement **40** may be made perceivable from the dial side. Alternatively, the entire case back **35** may be formed of a transparent material, and the entire movement **40** may be made perceivable from the case back side.
Escape Wheel and Pinion Portion
[0033] Next, the configuration of the escape wheel and pinion portion **100** will be described in detail.
[0034] FIG. **3** is a plan view illustrating the escape wheel and pinion portion **100**.
[0035] As illustrated in FIG. **3**, the escape wheel and pinion portion **100** has an insertion portion **110** into which a shaft member **102** is inserted in the central portion.
[0036] The escape wheel and pinion portion **100** has a rim portion **111** including a plurality of tooth portions **112** and a hold portion **115** to hold the shaft member **102**. The rim portion **111** is a ring-like portion of an outer edge of the escape wheel and pinion portion **100**. The tooth portion **112** is disposed protruding outward from the outer circumference of the rim portion **111** and is formed into a specific hook shape.
[0037] The escape wheel and pinion portion **100** has seven hold portions **115**. The hold portions **115** are arranged at seven places in the circumferential direction of the ring-like rim portion **111** with an equal pitch of 360°/7. In this regard, there is no particular limitation regarding the number of the hold portions **115**, and the number may be within the range of 3 to 7 or may be 7 or more.
[0038] The hold portion **115** has a first hold portion **113** extending from the rim portion **111** and a second hold portion **114** disposed by being branched from the first hold portion **113**. The first hold portion **113**, the second hold portion **114**, and the rim portion **111** are integrally formed of the same material.
[0039] The first hold portion **113** is formed extending from the rim portion **111** in the direction toward the shaft member **102** so that the width dimension decreases with increasing proximity to the shaft member **102**. An end on the shaft member **102** side of the first hold portion **113** is set to be a contact portion **113**A in contact with the shaft member **102**. The contact portion **113**A is formed having the shape of an arc in plan view.
[0040] The second hold portion **114** has a first portion **114**A and a second portion **114**B. The second hold portion **114** has functions of fixing the shaft member **102** to the center of the escape wheel and pinion portion **100** and suppressing the escape wheel and pinion portion **100** from inclining with respect to or coming out of the shaft member **102**.
[0041] The first portion **114**A is formed by being connected to the first hold portion **113** and by being branched from the first hold portion **113** and extends in the direction intersecting the extension direction of the first hold portion **113**. The second hold portion **114** has a plurality of first portions **114**A. The plurality of first portions **114**A are arranged substantially parallel to each other. The second portion **114**B is connected to the plurality of first portions **114**A and extends in the direction toward the shaft member **102**. The width direction of the second portion **114**B is substantially constant, and an end on the shaft member **102** side is set to be a contact portion **114**C in contact with the shaft member **102**. The contact portion **114**C is formed having the shape of an arc in plan view.
[0042] Next, the cross-sectional structure of the escape wheel and pinion portion **100** will be described. FIG. **4** is a partial sectional view of the escape wheel and pinion portion **100**.
[0043] As illustrated in FIG. **4**, the escape wheel and pinion portion **100** includes a base material **8**

containing silicon as a primary component. The base material **8** has a first surface **8**A, a second surface **8**B opposite to the first surface **8**A, and a third surface **8**C and a fourth surface **8**D, each connecting the first surface **8**A to the second surface **8**B.

[0044] In this regard, in the present specification, the first surface **8**A of the base material **8** means a surface on the watch-part perception side when a watch is equipped with the watch part.

[0045] When the watch is equipped with the watch part and the watch part can be perceived from the case back side of the watch, the first surface **8**A of the base material **8** means a surface located on the case back side of the watch. In this regard, when the watch part is perceived from the dial side and the case back side of the watch, the first surface **8**A of the base material **8** is assumed to be a surface located on the dial side of the watch.

[0046] Herein, in the present embodiment, since the escape wheel and pinion portion **100** serving as the watch part is perceived from the dial **3** side and the case back **35** side of the watch **1**, the first surface **8**A of the base material **8** is a surface located on the dial **3** side, and the second surface **8**B of the base material **8** is a surface located on the case back **35** side.

[0047] In the present specification, the base material **8** means a watch part in the state in which a light-reflecting layer **10** is not formed. In the present embodiment, the base material **8** means the escape wheel and pinion portion **100** in the state in which the light-reflecting layer **10** is not formed. That is, the base material **8** has the shape as a watch part, and in the present embodiment, the base material **8** has the shape of the escape wheel and pinion portion **100**.

[0048] In addition, in the present specification, “containing silicon as a primary component” means that the content of silicon on a mass basis relative to the total base material is 80% by mass or more. The silicon content is preferably 90% by mass or more and more preferably 95% by mass or more.

[0049] In the following explanations, the base material **8** containing silicon as a primary component is also referred to as the silicon base material **8** or simply as the base material **8**.

[0050] To begin with, the configuration on the first surface **8**A side of the base material **8** will be described.

[0051] As illustrated in FIG. **4**, the escape wheel and pinion portion **100** includes the light-reflecting layer **10** having a three-layer structure in which a first layer **12**, a second layer **14**, and a third layer **16** are stacked in this order on the first surface **8**A, the second surface **8**B, and the third surface **8**C of the base material **8**.

Base Material

[0052] The base material **8** contains silicon as a primary component. There is no particular limitation regarding the type of silicon, and appropriate silicon can be selected from the viewpoint of workability. Examples of silicon include single crystal silicon and polycrystal silicon. One type of these may be used alone, or two or more types thereof may be used in combination.

[0053] Since the silicon base material **8** can be produced by, for example, a photolithography technology or an etching technology, a complex shape can be formed.

Light-Reflecting Layer

[0054] The light-reflecting layer **10** includes the first layer **12**, the second layer **14**, and the third layer **16** in this order on the base material **8**. In the present embodiment, the light-reflecting layer **10** is disposed on the first surface **8**A, the second surface **8**B, the third surface **8**C, and the fourth surface **8**D of the base material **8**, that is, on the entire surface of the base material **8**, and has a three-layer structure. The light-reflecting layer may have, for example, a five-layer structure, but a three-layer structure is favorable from the viewpoint of readily adjusting the color.

First Layer

[0055] The first layer **12** is disposed on the base material **8**. In the present embodiment, the first layer **12** is disposed on the first surface **8**A, the second surface **8**B, the third surface **8**C, and the fourth surface **8**D of the base material **8**. In this regard, in the present embodiment, the first layer **12** is formed using silicon oxide.

[0056] The layer thickness of the first layer **12** is appropriately adjusted in accordance with the color of color development and may be usually 50 nm or more and 600 nm or less. Consequently, since the first layer **12** is 50 nm or more, the layer thickness of the first layer **12** can be readily controlled. In addition, since the first layer **12** is 600 nm or less, formation of the first layer **12** can be suppressed from taking excessive time.
[0057] In this regard, the first layer **12** may be a silicon oxide layer formed by a thermal oxidation method. The silicon oxide layer being formed by the thermal oxidation method tends to obtain a silicon oxide layer having high homogeneity.
Second Layer
[0058] The second layer **14** is disposed on the first layer **12**. In the present embodiment, the second layer **14** is disposed on the entire surface of the first layer **12**. In addition, in the present embodiment, the second layer **14** is formed using silicon.
[0059] In this regard, the second layer **14** may be an amorphous layer or a polysilicon layer, but a polysilicon layer is favorable.
[0060] The layer thickness of the second layer **14** is appropriately adjusted in accordance with the color of color development and may be usually 20 nm or more and 300 nm or less. Consequently, since the second layer **14** is 20 nm or more, the layer thickness of the second layer **14** can be readily controlled. In addition, since the layer thickness of the second layer **14** is 300 nm or less, excessive approach to the hue of the second layer **14** having a high refractive index can be suppressed.
Third Layer
[0061] The third layer **16** is disposed on the second layer **14**. In the present embodiment, the third layer **16** is disposed on the entire surface of the second layer **14**. In this regard, in the present embodiment, the third layer **16** is formed of a material having a refractive index different from that of the second layer **14** by using an atomic layer deposition method (ALD method). Specifically, the third layer **16** is formed using any one of aluminum oxide, aluminum nitride, silicon nitride, titanium oxide, and hafnium oxide by the ALD method.
[0062] Herein, the ALD method is a technology to form a metal oxide film or a metal nitride film on an object by alternately passing a gas containing a metal element called a precursor and a reaction species gas called a reactant, for example, water, ozone, oxygen, or ammonia. One of the features of the ALD method is that various types of film species can be made into a film since many materials serve as the precursor.
[0063] The layer thickness of the third layer **16** is appropriately adjusted in accordance with the color of color development and may be usually 10 nm or more and 150 nm or less. Consequently, since the third layer **16** is 10 nm or more, the reflectance due to the third layer **16** can be ensured and a predetermined hue can be readily realized. In addition, since the third layer **16** is 150 nm or less, formation of the third layer **16** can be suppressed from taking excessive time.
[0064] Further, the refractive index of the third layer **16** at a wavelength of 632.8 nm may be 1.7 or more and 2.7 or less. Consequently, a difference in the refractive index between the second layer **14** formed using silicon and the third layer **16** being decreased enables color development to be suppressed and enables a quiet, deep watch part to be realized.
[0065] In this regard, the refractive index is a value intrinsic to a substance. Regarding the refractive index of the material for forming the third layer **16** exemplified above, aluminum oxide is 1.7, aluminum nitride is 2.0, silicon nitride is 1.8, titanium oxide is 2.5 to 2.7, and hafnium oxide is 1.9. That is, the refractive index of the third layer **16** can be set to be 1.7 or more and 2.7 or less by adopting any one of aluminum oxide, aluminum nitride, silicon nitride, titanium oxide, and hafnium oxide as the material for forming the third layer **16**.
Light Reflectance Due to Light-Reflecting Layer
[0066] Next, the light reflectance due to a light-reflecting layer in which three layers of films are stacked will be described.

[0067] FIG. **5** is a model diagram illustrating the light reflection by a light-reflecting layer.
[0068] When light is incident on a light-reflecting layer in which three layers of films are stacked as illustrated in FIG. **5** at an incident angle of 0°, the reflectance R of the light is determined by Formula (1) to Formula (5) below described in "Fotonikku Kesshou Nyuumon (Introduction to Photonic Crystal)" (Kazuaki Sakota, Morikita Publishing Co., Ltd., p. 28-32, 41-43, 2004).

[00001] $$M_j = \begin{pmatrix} \frac{n_j + n_{j+1}}{2n_j} e^{\frac{-i2}{}(n_j - n_{j+1})d_j} & \frac{n_j - n_{j+1}}{2n_j} e^{\frac{-i2}{}(n_j + n_{j+1})d_j} \\ \frac{n_j - n_{j+1}}{2n_j} e^{\frac{i2}{}(n_j + n_{j+1})d_j} & \frac{n_j + n_{j+1}}{2n_j} e^{\frac{i2}{}(n_j - n_{j+1})d_j} \end{pmatrix} \quad \text{Formula(1)}$$

$$\begin{pmatrix} A_j \\ B_j \end{pmatrix} = M_j \begin{pmatrix} A_{j+1} \\ B_{j+1} \end{pmatrix} \quad \text{Formula(2)} \quad M = M_0 M_1 M_2 M_3 \quad \text{Formula(3)}$$

$$\begin{pmatrix} E_i \\ E_r \end{pmatrix} = M \begin{pmatrix} E_t \\ 0 \end{pmatrix} = \begin{pmatrix} M_{11} E_t \\ M_{21} E_t \end{pmatrix} \quad \text{Formula(4)}$$

$$R = .\text{Math.} \frac{E_r}{E_i} .\text{Math.}^2 = .\text{Math.} \frac{M_{21}}{M_{11}} .\text{Math.}^2 \quad \text{Formula(5)}$$

[0069] In Formula (1) to Formula (5), A denotes a wavelength of the light, n denotes a refractive index of the jth layer, d.sub.j denotes a layer thickness up to the jth layer, E.sub.i denotes an amplitude of the incident light, E.sub.r denotes an amplitude of the reflected light, and E.sub.t denotes an amplitude of the transmitted light. In addition, A.sub.j denotes an amplitude of the light that propagates through each layer in the same direction as E.sub.i, and B.sub.j denotes an amplitude of the light that propagates through each layer in the same direction as E.sub.r.
[0070] Herein, according to Formula (5) indicating the reflectance R, it is clear that the reflectance R can be calculated by the ratio of the **21** component to the **11** component of the matrix M. Further, each component of M is determined by the refractive index n and the layer thickness d in addition to the wavelength λ. In this regard, the refractive index n is a value intrinsic to a substance and, therefore, is determined in accordance with the material for forming the film, and the layer thickness d can be adjusted to a predetermined value by adopting a suitable producing method. That is, to intensely reflect specific light, in other words, to realize a predetermined hue, it is sufficient that production be performed so as to make the refractive index n and the layer thickness d to satisfy a specific condition.
[0071] Accordingly, in the present embodiment, since the ALD method is used for forming the third layer **16**, the third layer **16** can be formed using materials having various refractive indices. Therefore, a realizable hue can be increased.
[0072] In this regard, when the third layer is stacked by the thermal oxidation method on the second layer **14** formed using silicon, variations in the layer thicknesses of the silicon layer serving as the second layer **14** and the third layer **16** occur from production to production due to the crystallinity, density, and the like of the silicon layer serving as the second layer **14**. Consequently, there is a problem that it is difficult to perform adjustment to a predetermined hue. On the other hand, in the present embodiment, the layer thickness of the second layer **14** is not changed since the third layer **16** is formed by using the ALD method. Therefore, adjustment to a predetermined hue can be readily performed.
[0073] Further, since the first layer **12** formed using silicon oxide is stacked on the base material **8**, the durability of the base material **8** can be enhanced.
Producing Method of Escape Wheel and Pinion
[0074] Next, the producing method of the escape wheel and pinion **101** will be described.
[0075] FIG. **6** is a flow sheet illustrating the producing method of the escape wheel and pinion **101**.
[0076] As illustrated in FIG. **6**, initially, in Step S**1**, an oxide film formation step is performed. Specifically, a silicon oxide film is formed on one flat surface of a tabular silicon wafer formed

using silicon.
[0077] Subsequently, in Step S**2**, a photoresist application step is performed. Specifically, a photoresist is applied to the other flat surface of the silicon wafer, and drying is performed.
[0078] In Step S**3**, an exposure-development step is performed. Specifically, a mask having the shapes of the base material **8** of the escape wheel and pinion portion **100** and a tie bar is formed.
[0079] In Step S**4**, an etching step is performed. Specifically, the silicon wafer is etched so as to form the shapes of the base material **8** of the escape wheel and pinion portion **100** and the tie bar supporting the base material **8**. Herein, the silicon oxide film formed in Step S**1** suppresses a hole formed by etching from passing through.
[0080] In Step S**5**, an oxide film removal step is performed. Specifically, the silicon oxide film formed in Step S**1** is removed.
[0081] In Step S**6**, a first layer formation step is performed. Specifically, the first layer **12** is formed using silicon oxide by a thermal oxidation method on the entire surface of the silicon wafer etched in Step S**5**.
[0082] In Step S**7**, a second layer formation step is performed. Specifically, the second layer **14** is formed using silicon by a low-pressure CVD method on the entire surface of the first layer **12** formed in Step S**6**.
[0083] In Step S**8**, a third layer formation step is performed. Specifically, the third layer **16** is formed by the ALD method on the entire surface of the second layer **14** formed in Step S**7**. In such an instance, the third layer **16** is formed using a material having a refractive index different from that of the second layer **14**, for example, any one of aluminum oxide, aluminum nitride, silicon nitride, titanium oxide, and hafnium oxide by using the ALD method.
[0084] In Step S**9**, a tie bar cut step is performed. Specifically, the base material **8** of the escape wheel and pinion portion **100** is cut from the tie bar supporting the base material **8**.
[0085] Finally, in Step S**10**, an assembly step is performed. Specifically, the escape wheel and pinion **101** is assembled by combining the base material **8** of the escape wheel and pinion portion **100** cut from the tie bar in Step S**9** and the shaft member **102**.
[0086] Accordingly, in the present embodiment, since the ALD method is used for forming the third layer **16**, the third layer **16** can be formed using materials having various refractive indices. Therefore, a realizable hue can be increased.
[0087] In this regard, since a reflecting layer stacking step of stacking the light-reflecting layer **10** on the entire surface of the base material **8** is performed before the tie bar cut step of cutting the tie bar supporting the base material **8**, the light-reflecting layer **10** can be stacked on the entire surface of the base material **8**. Further, since the light-reflecting layer **10** is also stacked on the surface of the tie bar, when the tie bar is cut, a change in the hue of the cut place can be made inconspicuous.
[0088] Further, in the present embodiment, since the first layer **12** is formed by the thermal oxidation method, and the second layer **14** is formed by the low-pressure CVD method, that is, since the first layer **12** and the second layer **14** are formed by methods other than the ALD method, the time for producing the escape wheel and pinion portion **100** can be decreased.
Example 1
[0089] Next, Examples according to the present disclosure will be described.
[0090] In Example 1, light-reflecting layers were formed on the surface of the respective base materials under five conditions presented in Table 1.
[0091] As presented in Table 1, the third layer was formed of silicon nitride by the ALD method in Examples 1-1, 1-4, and 1-5, the third layer was formed of aluminum oxide by the ALD method in Example 1-2, and the third layer was formed of aluminum nitride by the ALD method in Example 1-3. Consequently, the refractive index of the third layer was 1.7 to 2.0. In Examples 1-1 to 1-5, the first layer was formed of silicon oxide by the thermal oxidation method, and the second layer was formed of silicon by the low-pressure CVD method. In this regard, in Table 1, the layer thickness of the first layer includes a production error of ±5 nm, the layer thickness of the second layer

includes a production error of ±3 nm, and the layer thickness of the third layer includes a production error of ±5 nm.
[0092] As a result, Examples 1-1 to 1-5 indicated that adjustment was able to be performed, and thereby the hue was red, the brightness L* was within the range of 45.0±10.0, a* was within the range of 60.0±10.0, and b* was within the range of 40.0±10.0. That is, it was indicated that the third layer being formed by the ALD method enables a quiet, deep watch part having a hue of red and brightness L* of 45.0±10.0 to be obtained.
[0093] In this regard, the brightness L* is a value of brightness in the L*a*b* color space specified by CIE (Commission Internationale d'Eclairage). The value of L* of “0” is the brightness of a substance that does not reflect light at all (completely absorb light), and the value of L* of “100” expresses the value of brightness of white that completely reflects light. In addition, the chroma C* is an indicator of the vividness of a color and is represented by a distance between a point expressed by a* and b* and the origin corresponding to an achromatic color.
[00002] $C^* = \sqrt{(a^*)^2 + (b^*)^2}$ Formula(6)
TABLE-US-00001 TABLE 1 Example Example Example Example Example 1-1 1-2 1-3 1-4 1-5 First Material silicon silicon silicon silicon silicon layer oxide oxide oxide oxide oxide Layer thickness 170 nm 162 nm 350 nm 170 nm 355 nm Refractive index 1.5 1.5 1.5 1.5 1.5 Second Material silicon silicon silicon silicon silicon layer Layer thickness 107 nm 108 nm 105 mm 175 nm 107 nm Refractive index 4.1 4.1 4.1 4.1 4.1 Third Material silicon aluminum aluminum silicon silicon layer nitride oxide nitride nitride nitride Layer thickness 55 mm 66 nm 55 mm 55 nm 55 nm Refractive index 1.8 1.7 2.0 1.8 1.8 L* 42.1 52.8 37.6 43.7 50.8 a* 55.4 52.1 57.2 51.7 60.4 b* 41.1 33.1 34.9 44.3 32.4 Hue red red red red red
Example 2
[0094] In Example 2, light-reflecting layers were formed on the surface of the respective base materials under four conditions presented in Table 2.
[0095] As presented in Table 2, the third layer was formed of aluminum oxide by the ALD method in Examples 2-1 and 2-4, the third layer was formed of silicon nitride by the ALD method in Example 2-2, and the third layer was formed of titanium oxide in Example 2-3. Consequently, the refractive index of the third layer was 1.7 to 2.7. In Examples 2-1 to 2-4, the first layer was formed of silicon oxide by the thermal oxidation method, and the second layer was formed of silicon by the low-pressure CVD method. In this regard, in Table 2, the layer thickness of the first layer includes a production error of ±5 nm, the layer thickness of the second layer includes a production error of ±3 nm, and the layer thickness of the third layer includes a production error of ±5 nm.
[0096] As a result, Examples 2-1 to 2-4 indicated that adjustment was able to be performed, and thereby the hue was green, the brightness L* was within the range of 65.0±10.0, a* was within the range of −65.0±10.0, and b* was within the range of 50.0±10.0. That is, it was indicated that the third layer being formed by the ALD method enables a quiet, deep watch part having a hue of green and brightness L* of 65.0±10.0 to be obtained.
TABLE-US-00002 TABLE 2 Example Example Example Example 2-1 2-2 2-3 2-4 First layer Material silicon silicon silicon silicon oxide oxide oxide oxide Layer thickness 450 mm 450 nm 430 nm 255 nm Refractive index 1.5 1.5 1.5 1.5 Second layer Material silicon silicon silicon silicon Layer thickness 85 nm 80 nm 79 nm 85 nm Refractive index 4.1 4.1 4.1 4.1 Third layer Material aluminum silicon titanium aluminum oxide nitride oxide oxide Layer thickness 51 nm 55 mm 36 mm 51 nm Refractive index 1.7 1.8 2.5-2.7 1.7 L* 72.3 66.3 68.6 73.4 a* −63.9 −58.9 −60.9 −59.7 b* 51.1 55.0 52.3 44.8 Hue green green green green
Example 3
[0097] In Example 3, light-reflecting layers were formed on the surface of the respective base materials under three conditions presented in Table 3.
[0098] As presented in Table 3, the third layer was formed of aluminum oxide by the ALD method

in Examples 3-1 and 3-3, and the third layer was formed of aluminum nitride by the ALD method in Example 3-2. Consequently, the refractive index of the third layer was 1.7 to 2.0. In Examples 3-1 to 3-3, the first layer was formed of silicon oxide by the thermal oxidation method, and the second layer was formed of silicon by the low-pressure CVD method. In this regard, in Table 3, the layer thickness of the first layer includes a production error of ±5 nm, the layer thickness of the second layer includes a production error of ±3 nm, and the layer thickness of the third layer includes a production error of ±5 nm.

[0099] As a result, Examples 3-1 to 3-3 indicated that adjustment was able to be performed, and thereby the hue was yellow, the brightness L* was within the range of 80.0±10.0, a* was within the range of −5.0±10.0, and b* was within the range of 83.0±10.0. That is, it was indicated that the third layer being formed by the ALD method enables a quiet, deep watch part having a hue of yellow and brightness L* of 80.0±10.0 to be obtained.

[0100] Accordingly, in the present disclosure, the third layer being formed of a material having a refractive index of 1.7 to 2.7 enables the brightness L* when the hue is red to be adjusted to 45.0±10.0, enables the brightness L* when the hue is green to be adjusted to 65.0±10.0, and enables the brightness L* when the hue is yellow to be adjusted to 80.0±10.0. Consequently, a quiet, deep color with a predetermined hue can be realized.

TABLE-US-00003 TABLE 3 Example 3-1 Example 3-2 Example 3-3 First layer Material silicon oxide silicon oxide silicon oxide Layer thickness 295 nm 295 nm 295 nm Refractive index 1.5 1.5 1.5 Second layer Material silicon silicon silicon Layer thickness 38 nm 83 nm 95 nm Refractive index 4.1 4.1 4.1 Third layer Material aluminum oxide aluminum nitride aluminum oxide Layer thickness 60 nm 54 mm 60 nm Refractive index 1.7 2.0 1.7 L* 82.4 74.2 77.8 a* −3.2 −12.1 −3.6 b* 84.5 80.3 75.9 Hue yellow yellow yellow

Modified Example

[0101] In this regard, the present disclosure is not limited to the above-described embodiment, and modifications, improvements, and the like within a range in which the purpose of the present disclosure can be achieved are included in the present disclosure.

[0102] In the above-described embodiment, the watch part according to the present disclosure is configured to serve as the escape wheel and pinion portion **100**, but the watch part is not limited to this. For example, the watch part according to the present disclosure may be configured to serve as a part housed in a case, such as a movement barrel complete, an ordinal number wheel and pinion, an escape wheel and pinion, a pallet folk, a balance with hairspring, and a mainspring.

[0103] The escape wheel and pinion portion **100** according to the above-described embodiment may include an antifouling layer or an antistatic layer having transparency as an outermost layer within the bounds of not impairing the decorativeness. Accordingly, the escape wheel and pinion portion **100** is provided with an antifouling function or an antistatic function.

[0104] In addition, as the situation demands, a step for any purpose can be added to the producing method of the escape wheel and pinion portion **100** according to the above-described embodiment. For example, an intermediate treatment, such as washing, may be performed between the steps.

Outline of the Present Disclosure

[0105] A watch part according to the present disclosure includes a base material having a watch part shape and containing silicon as a primary component and a light-reflecting layer stacked on the base material, wherein the light-reflecting layer includes a first layer, a second layer, and a third layer which are successively stacked in this order from the base material, the first layer is formed using silicon oxide, the second layer is formed using silicon, and the third layer is formed using a material having a refractive index of 1.7 to 2.7.

[0106] In the present disclosure, since the third layer is formed using a material having a refractive index of 1.7 to 2.7, a difference in the refractive index between the second layer formed using silicon and the third layer can be decreased. Consequently, color development is suppressed and a quiet, deep watch part can be realized.

[0107] In this regard, when the third layer is stacked by the thermal oxidation method on the second layer formed using silicon, variations in the layer thicknesses of the silicon layer serving as the second layer **14** and the third layer **16** occur from production to production due to the crystallinity, density, and the like of the silicon layer serving as the second layer **14**. Consequently, there is a problem that it is difficult to perform adjustment to obtain a predetermined hue. On the other hand, in the present disclosure, the layer thickness of the second layer **14** is not changed since the third layer is formed by using the ALD method. Therefore, adjustment to obtain a predetermined hue can be readily performed.
[0108] Further, since the first layer formed using silicon oxide is stacked on the base material, the durability of the base material can be enhanced.
[0109] In the watch part according to the present disclosure, L*=45.0±10, a*=60.0±10, and b*=40.0±10 may apply in the L*a*b* color space specified by CIE.
[0110] Accordingly, a quiet, deep watch part having a hue of red and brightness L* of 45.0±10.0 can be obtained.
[0111] In the watch part according to the present disclosure, the third layer may be formed using any one of aluminum oxide, aluminum nitride, silicon nitride, titanium oxide, and hafnium oxide.
[0112] Accordingly, the refractive index of the third layer at a wavelength of 632.8 nm can be set to be 1.7 to 2.7.
[0113] In the watch part according to the present disclosure, the third layer may be formed using aluminum oxide, a layer thickness of the first layer may be 162±5 nm, a layer thickness of the second layer may be 108±3 nm, and a layer thickness of the third layer may be 66±5 nm.
[0114] Accordingly, a quiet, deep watch part having a hue of red and brightness L* of 45.0±10.0 can be obtained.
[0115] In the watch part according to the present disclosure, the third layer may be formed using silicon nitride, a layer thickness of the first layer may be 170±5 nm, a layer thickness of the second layer may be 107±3 nm, and a layer thickness of the third layer may be 55±5 nm.
[0116] Accordingly, a quiet, deep watch part having a hue of red and brightness L* of 45.0±10.0 can be obtained.
[0117] In the watch part according to the present disclosure, the third layer may be formed using aluminum nitride, a layer thickness of the first layer may be 350±5 nm, a layer thickness of the second layer may be 105±3 nm, and a layer thickness of the third layer may be 55±5 nm.
[0118] Accordingly, a quiet, deep watch part having a hue of red and brightness L* of 45.0±10.0 can be obtained.
[0119] In the watch part according to the present disclosure, L*=65.0±10, a*=−65.0±10, and b*=50.0±10 may apply in the L*a*b* color space specified by CIE.
[0120] Accordingly, a quiet, deep watch part having a hue of green and brightness L* of 65.0±10.0 can be obtained.
[0121] In the watch part according to the present disclosure, the third layer may be formed using aluminum oxide, a layer thickness of the first layer may be 450±5 nm, a layer thickness of the second layer may be 85±3 nm, and a layer thickness of the third layer may be 51±5 nm.
[0122] Accordingly, a quiet, deep watch part having a hue of green and brightness L* of 65.0±10.0 can be obtained.
[0123] In the watch part according to the present disclosure, the third layer may be formed using silicon nitride, a layer thickness of the first layer may be 450±5 nm, a layer thickness of the second layer may be 80±3 nm, and a layer thickness of the third layer may be 55±5 nm.
[0124] Accordingly, a quiet, deep watch part having a hue of green and brightness L* of 65.0±10.0 can be obtained.
[0125] In the watch part according to the present disclosure, the third layer may be formed using titanium oxide, a layer thickness of the first layer may be 430±5 nm, a layer thickness of the second layer may be 79±3 nm, and a layer thickness of the third layer may be 36±5 nm.

[0126] Accordingly, a quiet, deep watch part having a hue of green and brightness L* of 65.0±10.0 can be obtained.
[0127] In the watch part according to the present disclosure, L*=80.0±10, a*=−5.0±10, and b*=83.0±10 may apply in the L*a*b* color space specified by CIE.
[0128] Accordingly, a quiet, deep watch part having a hue of yellow and brightness L* of 80.0±10.0 can be obtained.
[0129] In the watch part according to the present disclosure, the third layer may be formed using aluminum oxide, a layer thickness of the first layer may be 295±5 nm, a layer thickness of the second layer may be 38±3 nm, and a layer thickness of the third layer may be 60±5 nm.
[0130] Accordingly, a quiet, deep watch part having a hue of yellow and brightness L* of 80.0±10.0 can be obtained.
[0131] In the watch part according to the present disclosure, the third layer may be formed using aluminum nitride, a layer thickness of the first layer may be 295±5 nm, a layer thickness of the second layer may be 83±3 nm, and a layer thickness of the third layer may be 54±5 nm.
[0132] Accordingly, a quiet, deep watch part having a hue of yellow and brightness L* of 80.0±10.0 can be obtained.
[0133] A watch according to the present disclosure includes the above-described watch part.

Claims

1. A watch part comprising: a base material having a watch part shape and containing silicon as a primary component; and a light-reflecting layer stacked on the base material, wherein the light-reflecting layer includes a first layer, a second layer, and a third layer which are successively stacked in this order from the base material, the first layer is formed using silicon oxide, the second layer is formed using silicon, and the third layer is formed using a material having a refractive index of 1.7 to 2.7.
2. The watch part according to claim 1, wherein L*=45.0±10, a*=60.0±10, and b*=40.0±10 apply in the L*a*b* color space specified by CIE.
3. The watch part according to claim 1, wherein the third layer is formed using any one of aluminum oxide, aluminum nitride, silicon nitride, titanium oxide, and hafnium oxide.
4. The watch part according to claim 1, wherein the third layer is formed using aluminum oxide, a layer thickness of the first layer is 162±5 nm, a layer thickness of the second layer is 108±3 nm, and a layer thickness of the third layer is 66±5 nm.
5. The watch part according to claim 1, wherein the third layer is formed using silicon nitride, a layer thickness of the first layer is 170±5 nm, a layer thickness of the second layer is 107±3 nm, and a layer thickness of the third layer is 55±5 nm.
6. The watch part according to claim 1, wherein the third layer is formed using aluminum nitride, a layer thickness of the first layer is 350±5 nm, a layer thickness of the second layer is 105±3 nm, and a layer thickness of the third layer is 55±5 nm.
7. The watch part according to claim 1, wherein L*=65.0±10, a*=−65.0±10, and b*=50.0±10 apply in the L*a*b* color space specified by CIE.
8. The watch part according to claim 1, wherein the third layer is formed using aluminum oxide, a layer thickness of the first layer is 450±5 nm, a layer thickness of the second layer is 85±3 nm, and a layer thickness of the third layer is 51±5 nm.
9. The watch part according to claim 1, wherein the third layer is formed using silicon nitride, a layer thickness of the first layer is 450±5 nm, a layer thickness of the second layer is 80±3 nm, and a layer thickness of the third layer is 55±5 nm.
10. The watch part according to claim 1, wherein the third layer is formed using titanium oxide, a layer thickness of the first layer is 430±5 nm, a layer thickness of the second layer is 79±3 nm, and a layer thickness of the third layer is 36±5 nm.

11. The watch part according to claim 1, wherein L*=80.0±10, a*=−5.0±10, and b*=83.0±10 apply in the L*a*b* color space specified by CIE.

12, The watch part according to claim 1, wherein the third layer is formed using aluminum oxide, a layer thickness of the first layer is 295±5 nm, a layer thickness of the second layer is 38±3 nm, and a layer thickness of the third layer is 60±5 nm.

13. The watch part according to claim 1, wherein the third layer is formed using aluminum nitride, a layer thickness of the first layer is 295±5 nm, a layer thickness of the second layer is 83±3 nm, and a layer thickness of the third layer is 54±5 nm.

14. The watch part according to claim 1, wherein the third layer is formed by using an ALD method.

15. A watch comprising the watch part according to claim 1.