MICROCRYSTALLINE GLASS, MICROCRYSTALLINE GLASS PRODUCT AND MANUFACTURING METHOD THEREFOR

TECHNICAL FIELD

[0001] The present application relates to a microcrystalline glass, and in particular to a microcrystalline glass suitable for chemical strengthening.

BACKGROUND

[0002] In recent years, with the continuous rise and development of consumer electronic products, glass, as a transparent material with excellent performance, has been widely used in electronic devices. Since electronic devices contain numerous precision electronic components inside, cover plates or housings are required to protect the internal electronic components. As market demands diversify, the usage scenarios of protective cover glass have become increasingly complex. Its functions are no longer limited to protecting internal electronic components, and in some cases, additional functions are required. For example, in the vital sign monitoring of smart watches, the glass material is required to be locally transparent, but in other regions it needs to be light-shielding to avoid interference from stray light. Therefore, the glass material is required to have both blackened and transparent parts at the same time, which poses new challenges to glass manufacturing technology. In existing technologies, the above-mentioned cover plate material can be manufactured by an embedding approach with two different materials: a transparent material and a blackened material. However, due to the differences in strength and the significant mismatch in coefficient of thermal expansion between the two materials, the need to process through holes, and the presence of micro-cracks on the inner wall of the glass, the strength of the cover plate material is compromised. Moreover, processing relatively small holes or irregularly shaped patterns is difficult, resulting in high manufacturing costs.

[0003] Photosensitive microcrystalline glass is a type of microcrystalline glass obtained by irradiating a matrix glass with ultraviolet light to result structural changes within the glass body so as to form crystal nuclei, and then performing a heat treatment at a certain temperature to yield a large number of specific crystals in the irradiated regions. The exposed portion exhibits high crystallinity, darkened glass color, and decreased light transmittance. The unexposed portion remains uncrystallized and transparent. Therefore, by mask exposure, it is possible to realize the simultaneous presence of blackened and transparent regions in the glass material. On the other hand, the glass material used for manufacturing protective cover plates also needs to have excellent mechanical properties to withstand conventional “touch” contact during long-term use, as well as possible accidental bending, scratching, and impact damage. To improve resistance against damage caused by accidental external forces, the strength of the glass material can be enhanced by chemical strengthening. However, in the prior art, the photosensitive microcrystalline glass cannot be chemically strengthened, or can only be poorly chemically strengthened due to inherent “inhomogeneity” of the photosensitive microcrystalline glass, i.e., the structural difference between the crystallized portion and the uncrystallized portion, making it difficult to meet the requirements of high-performance electronic devices or the like.

SUMMARY

[0004] In view of the above reasons, the technical issue to be addressed by the present application is to provide a matrix glass for manufacturing a microcrystalline glass having a blackened portion and a transparent

portion.

[0005] The present application further provides a microcrystalline glass suitable for chemical strengthening. The microcrystalline glass and the microcrystalline glass product made therefrom have excellent mechanical properties.

[0006] The technical solutions adopted by the present application to address the technical issue are as follows:

[0007] (1) A microcrystalline glass product includes the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, and Ag_2O: 0.01% to 0.8%. The R_2O is one or both of Na_2O and K_2O.

[0008] (2) The microcrystalline glass product according to (1) further includes the following components in percentage by weight: Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0009] (3) A microcrystalline glass product consists of the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%, Sb_2O_3: 0% to 1%, SnO_2: 0% to 0.5%, MO: 0% to 5%, Ln_2O_3: 0% to 5%, and Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0010] (4) A microcrystalline glass product includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, ZrO_2, CeO_2 and Ag_2O, wherein the R_2O is one or both of Na_2O and K_2O. A ball drop test height II of the microcrystalline glass product is equal to or greater than 800 mm.

[0011] (5) A microcrystalline glass product includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass product contains a lithium metasilicate crystalline phase. In the blackened portion of the microcrystalline glass product, a weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50%.

[0012] (6) A microcrystalline glass product includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, ZrO_2, CeO_2, and Ag_2O. The R_2O is one or both of Na_2O and K_2O. The microcrystalline glass product includes one or more blackened portions and one or more transparent portions.

[0013] (7) A microcrystalline glass product includes the following components: SiO_2, Li_2O, Al_2O_3, and ZrO_2. The components in percentage by weight satisfy: SiO_2/Li_2O is in a range from 5.5 to 10.0.

[0014] (8) A microcrystalline glass product includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1.

[0015] (9) A microcrystalline glass product includes the following components: SiO_2, Li_2O, Al_2O_3, and ZrO_2. The components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0.

[0016] (10) A microcrystalline glass product includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2, and the R_2O is one or both of Na_2O and K_2O. The microcrystalline glass product contains a lithium

metasilicate crystalline phase. A weight percentage of the lithium metasilicate crystalline phase is greater than that of another crystalline phase.

[0017] (11) A microcrystalline glass product includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass product has a thickness of 0.2 mm to 1.5 mm, and a transmittance $T_{870\,nm}$ of the blackened portion of the microcrystalline glass product at a wavelength of 870 nm is equal to or less than 15.0%.

[0018] (12) A microcrystalline glass product includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass product has a thickness of 0.2 mm to 1.5 mm, and a transmittance $T_{940\,nm}$ of the blackened portion of the microcrystalline glass product at a wavelength of 940 nm is equal to or less than 50.0%.

[0019] (13) The microcrystalline glass product according to any one of (4) to (12) includes the following components in percentage by weight: SiO_2: 65% to 78%, and/or R_2O: 2% to 12%, and/or Li_2O: 5% to 15%, and/or Al_2O_3: 3% to 12%, and/or ZrO_2: 1.5% to 10%, and/or CeO_2: 0.01% to 0.6%, and/or Ag_2O: 0.01% to 0.8%, and/or Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0020] (14) The microcrystalline glass product according to any one of (1) to (13), wherein the components in percentage by weight satisfy: SiO_2/Li_2O is in a range from 5.5 to 10.0, preferably SiO_2/Li_2O is in a range from 6.0 to 9.0, and more preferably SiO_2/Li_2O is in a range from 7.0 to 8.5.

[0021] (15) The microcrystalline glass product according to any one of (1) to (14), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0, preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5, and more preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6.

[0022] (16) The microcrystalline glass product according to any one of (1) to (15), wherein the components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1, preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5, and more preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5.

[0023] (17) The microcrystalline glass product according to any one of (1) to (16), wherein the components in percentage by weight satisfy: Ag_2O/CeO_2 is in a range from 1.0 to 10.0, preferably Ag_2O/CeO_2 is in a range from 1.5 to 6.5, and more preferably Ag_2O/CeO_2 is in a range from 2.0 to 4.5.

[0024] (18) The microcrystalline glass product according to any one of (1) to (17), wherein the components in percentage by weight satisfy: Li_2O/ZrO_2 is in a range from 1.0 to 7.5, preferably Li_2O/ZrO_2 is in a range from 1.2 to 5.0, more preferably Li_2O/ZrO_2 is in a range from 1.4 to 4.3, and even more preferably Li_2O/ZrO_2 is in a range from 1.6 to 3.0.

[0025] (19) The microcrystalline glass product according to any one of (1) to (18), wherein the components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0, preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0, more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 12.0

to 25.0, and even more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0.

[0026] (20) The microcrystalline glass product according to any one of (1) to (19), wherein the components in percentage by weight satisfy: $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0, preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0, more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 8.5 to 20.0, and even more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0.

[0027] (21) The microcrystalline glass product according to any one of (1) to (20), wherein the components in percentage by weight satisfy: $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0, preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0, more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 5.0 to 12.5, and even more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0.

[0028] (22) The microcrystalline glass product according to any one of (1) to (21), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0, preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0, more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.7 to 3.7, and even more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2.

[0029] (23) The microcrystalline glass product according to any one of (1) to (22), wherein the components in percentage by weight satisfy: $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9, preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6, and more preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5.

[0030] (24) The microcrystalline glass product according to any one of (1) to (23), wherein the components in percentage by weight satisfy: $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%, preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%, more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 18.5% to 26%, and even more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%. The R_2O is one or both of Na_2O and K_2O.

[0031] (25) The microcrystalline glass product according to any one of (1) to (24), wherein the components in percentage by weight satisfy: $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5, preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5, more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.3 to 6.0, and even more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8.

[0032] (26) The microcrystalline glass product according to any one of (1) to (25), wherein the components in percentage by weight satisfy: MO/ZrO_2 is equal to or less than 2.5, preferably MO/ZrO_2 is equal to or less than 1.5, and more preferably MO/ZrO_2 is equal to or less than 0.5. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

[0033] (27) The microcrystalline glass product according to any one of (1) to (26), wherein the components in percentage by weight satisfy: $Sb_2O_3+SnO_2$: 0.05% to 1.2%, preferably $Sb_2O_3+SnO_2$: 0.1% to 1%, and more preferably $Sb_2O_3+SnO_2$: 0.2% to 0.7%.

[0034] (28) The microcrystalline glass product according to any one of (1) to (27) includes the following components in percentage by weight: SiO_2: 68% to 77%, preferably SiO_2: 69.5% to 75.5%; and/or R_2O: 3% to

10%, preferably R_2O: 4% to 8%; and/or Li_2O: 7% to 13%, preferably Li_2O: 8.5% to 12%; and/or Al_2O_3: 4% to 10%, preferably Al_2O_3: 5% to 9%; and/or ZrO_2: 2% to 8%, preferably ZrO_2: 3% to 6.5%; and/or CeO_2: 0.07% to 0.4%, preferably CeO_2: 0.08% to 0.3%; and/or Ag_2O: 0.1% to 0.6%, preferably Ag_2O: 0.2% to 0.5%; and/or Sb_2O_3: 0.01% to 0.7%, preferably Sb_2O_3: 0.07% to 0.5%; and/or SnO_2: 0% to 0.3%, preferably SnO_2: 0% to 0.2%; and/or MO: 0% to 3%, preferably MO: 0% to 1%, more preferably MO is not contained; and/or Ln_2O_3: 0% to 3%, preferably Ln_2O_3: 0% to 1%, more preferably Ln_2O_3 is not contained; and/or Fe_2O_3: 0% to 0.5%, preferably Fe_2O_3: 0% to 0.2%, more preferably Fe_2O_3 is not contained. The R_2O is one or both of Na_2O and K_2O, the MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and the Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0035] (29) The microcrystalline glass product according to any one of (1) to (28), wherein the microcrystalline glass product includes one or more blackened portions and one or more transparent portions, or the microcrystalline glass product as a whole is a blackened portion.

[0036] (30) The microcrystalline glass product according to any one of (1) to (29), wherein the microcrystalline glass product contains a lithium silicate crystalline phase, preferably contains a lithium metasilicate crystalline phase, and more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50% in the blackened portion of the microcrystalline glass product, even more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 40% in the blackened portion of the microcrystalline glass product, and still more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 10% to 30% in the blackened portion of the microcrystalline glass product.

[0037] (31) The microcrystalline glass product according to any one of (1) to (30), wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is equal to or greater than 85.0%, preferably is equal to or greater than 88.0%, more preferably is equal to or greater than 90.0%, even more preferably is equal to or greater than 91.0%, and still more preferably is in a range from 91.5% to 95.0%; and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%, preferably is less than or equal to 3.0%, more preferably is less than or equal to 1.5%, even more preferably is less than or equal to 1.2%, and still more preferably is less than or equal to 0.5%; and/or a transmittance $T_{870\ nm}$ of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is less than or equal to 15.0%, preferably in a range from 0.1% to 12.5%, more preferably in a range from 0.1% to 10%, even more preferably in a range from 0.1% to 8.0%, and still more preferably in a range from 0.1% to 5.0%; and/or a transmittance $T_{940\ nm}$ of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is equal to or less than 50.0%, preferably in a range from 0.1% to 35.0%, more preferably in a range from 0.3% to 20.0%, even more preferably in a range from 0.3% to 15.0%, and still more preferably in a range from 0.3% to 10.0%.

[0038] (32) The microcrystalline glass product according to any one of (1) to (31), wherein the thickness of the microcrystalline glass product is in a range from 0.5 mm to 1.5 mm, preferably in a range from 0.8 mm

to 1.2 mm, and more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0039] (33) The microcrystalline glass product according to any one of (1) to (32), wherein the ball drop test height II of the microcrystalline glass product is greater than or equal to 800 mm, preferably greater than or equal to 900 mm, more preferably greater than or equal to 1000 mm, and even more preferably greater than or equal to 1100 mm.

[0040] (34) A microcrystalline glass includes the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%. The R_2O is one or both of Na_2O and K_2O.

[0041] (35) The microcrystalline glass according to (34) further includes the following components in percentage by weight: Sb_2O_3: 0% to 1%; and/or SnO_2: 0% to 0.5%; and/or MO: 0% to 5%; and/or Ln_2O_3: 0% to 5%; and/or Fe_2O_3: 0% to 1%. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0042] (36) A microcrystalline glass consists of the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%, Sb_2O_3: 0% to 1%, SnO_2: 0% to 0.5%, MO: 0% to 5%, Ln_2O_3: 0% to 5%, and Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0043] (37) A microcrystalline glass includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass contains a lithium metasilicate crystalline phase, and in the blackened portion of the microcrystalline glass, the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50%.

[0044] (38) A microcrystalline glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, ZrO_2, CeO_2, and Ag_2O. The R_2O is one or both of Na_2O and K_2O. The microcrystalline glass includes one or more blackened portions and one or more transparent portions.

[0045] (39) A microcrystalline glass includes the components in percentage by weight: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. SiO_2/Li_2O is in a range from 5.5 to 10.0.

[0046] (40) A microcrystalline glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1.

[0047] (41) A microcrystalline glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0.

[0048] (42) A microcrystalline glass includes the following components: SiO_2, Li_2O, Al_2O_3, CeO_2, and Ag_2O. The components in percentage by weight satisfy: Ag_2O/CeO_2 is in a range from 1.0 to 10.0.

[0049] (43) A microcrystalline glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2, and the R_2O is one or both of Na_2O and K_2O. The microcrystalline glass contains a lithium metasilicate crystalline phase. A weight percentage of the lithium metasilicate crystalline phase is greater than that of

another crystalline phase.

[0050] (44) A microcrystalline glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2, and the R_2O is one or both of Na_2O and K_2O. The microcrystalline glass contains a lithium silicate crystalline phase.

[0051] (45) A microcrystalline glass includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass has a thickness of 0.2 mm to 1.5 mm, and a transmittance $T_{870\ nm}$ of the blackened portion of the microcrystalline glass at a wavelength of 870 nm is equal to or less than 15.0%.

[0052] (46) A microcrystalline glass includes one or more blackened portions and one or more transparent portions, wherein the microcrystalline glass has a thickness of 0.2 mm to 1.5 mm, and a transmittance $T_{940\ nm}$ of the blackened portion of the microcrystalline glass product at a wavelength of 940 nm is equal to or less than 50.0%.

[0053] (47) The microcrystalline glass according to any one of (37) to (46) includes the following components in percentage by weight: SiO_2: 65% to 78%, and/or R_2O: 2% to 12%, and/or Li_2O: 5% to 15%, and/or Al_2O_3: 3% to 12%, and/or ZrO_2: 1.5% to 10%, and/or CeO_2: 0.01% to 0.6%, and/or Ag_2O: 0.01% to 0.8%, and/or Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0054] (48) The microcrystalline glass according to any one of (34) to (47), wherein the components in percentage by weight satisfy: SiO_2/Li_2O is in a range from 5.5 to 10.0, preferably SiO_2/Li_2O is in a range from 6.0 to 9.0, and more preferably SiO_2/Li_2O is in a range from 7.0 to 8.5.

[0055] (49) The microcrystalline glass according to any one of (34) to (48), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0, preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5, and more preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6.

[0056] (50) The microcrystalline glass according to any one of (34) to (49), wherein the components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1, preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5, and more preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5.

[0057] (51) The microcrystalline glass according to any one of (34) to (50), wherein the components in percentage by weight satisfy: Ag_2O/CeO_2 is in a range from 1.0 to 10.0, preferably Ag_2O/CeO_2 is in a range from 1.5 to 6.5, and more preferably Ag_2O/CeO_2 is in a range from 2.0 to 4.5.

[0058] (52) The microcrystalline glass according to any one of (34) to (51), wherein the components in percentage by weight satisfy: Li_2O/ZrO_2 is in a range from 1.0 to 7.5, preferably Li_2O/ZrO_2 is in a range from 1.2 to 5.0, more preferably Li_2O/ZrO_2 is in a range from 1.4 to 4.3, and even more preferably Li_2O/ZrO_2 is in a range from 1.6 to 3.0.

[0059] (53) The microcrystalline glass according to any one of (34) to (52), wherein the components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0, preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0, more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 12.0 to 25.0, and even

more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0.

[0060] (54) The microcrystalline glass according to any one of (34) to (53), wherein the components in percentage by weight satisfy: $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0, preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0, more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 8.5 to 20.0, and even more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0.

[0061] (55) The microcrystalline glass according to any one of (34) to (54), wherein the components in percentage by weight satisfy: $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0, preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0, more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 5.0 to 12.5, and even more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0.

[0062] (56) The microcrystalline glass according to any one of (34) to (55), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0, preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0, more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.7 to 3.7, and even more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2.

[0063] (57) The microcrystalline glass according to any one of (34) to (56), wherein the components in percentage by weight satisfy: $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9, preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6, and more preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5.

[0064] (58) The microcrystalline glass according to any one of (34) to (57), wherein the components in percentage by weight satisfy: $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%, preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%, more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 18.5% to 26%, and even more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%. The R_2O is one or both of Na_2O and K_2O.

[0065] (59) The microcrystalline glass according to any one of (34) to (58), wherein the components in percentage by weight satisfy: $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5, preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5, more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.3 to 6.0, and even more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8.

[0066] (60) The microcrystalline glass according to any one of (34) to (59), wherein the components in percentage by weight satisfy: MO/ZrO_2 is equal to or less than 2.5, preferably MO/ZrO_2 is equal to or less than 1.5, and more preferably MO/ZrO_2 is equal to or less than 0.5. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

[0067] (61) The microcrystalline glass according to any one of (34) to (60), wherein the components in percentage by weight satisfy: $Sb_2O_3+SnO_2$: 0.05% to 1.2%, preferably $Sb_2O_3+SnO_2$: 0.1% to 1%, and more preferably $Sb_2O_3+SnO_2$: 0.2% to 0.7%.

[0068] (62) The microcrystalline glass according to any one of (34) to (61) includes the following components in percentage by weight: SiO_2: 68% to 77%, preferably SiO_2: 69.5% to 75.5%; and/or R_2O: 3% to 10%, preferably R_2O: 4% to 8%; and/or Li_2O: 7% to 13%, preferably Li_2O: 8.5% to 12%; and/or Al_2O_3: 4% to 10%, preferably Al_2O_3: 5% to 9%; and/or ZrO_2: 2% to 8%, preferably ZrO_2: 3% to 6.5%; and/or CeO_2: 0.07% to 0.4%, preferably CeO_2: 0.08% to 0.3%; and/or Ag_2O: 0.1% to 0.6%, preferably Ag_2O: 0.2% to 0.5%;

and/or Sb_2O_3: 0.01% to 0.7%, preferably Sb_2O_3: 0.07% to 0.5%; and/or SnO_2: 0% to 0.3%, preferably SnO_2: 0% to 0.2%; and/or MO: 0% to 3%, preferably MO: 0% to 1%, more preferably MO is not contained; and/or Ln_2O_3: 0% to 3%, preferably Ln_2O_3: 0% to 1%, more preferably Ln_2O_3 is not contained; and/or Fe_2O_3: 0% to 0.5%, preferably Fe_2O_3: 0% to 0.2%, more preferably Fe_2O_3 is not contained. The R_2O is one or both of Na_2O and K_2O, the MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and the Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0069] (63) The microcrystalline glass according to any one of (34) to (62), wherein the microcrystalline glass includes one or more blackened portions and one or more transparent portions, or the microcrystalline glass as a whole is a blackened portion.

[0070] (64) The microcrystalline glass according to any one of (34) to (63), wherein the microcrystalline glass contains a lithium silicate crystalline phase, preferably contains a lithium metasilicate crystalline phase, and more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50% in the blackened portion of the microcrystalline glass, even more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 40% in the blackened portion of the microcrystalline glass, and still more preferably the weight percentage of the lithium metasilicate crystalline phase is in a range from 10% to 30% in the blackened portion of the microcrystalline glass.

[0071] (65) The microcrystalline glass according to any one of (34) to (64), wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is equal to or greater than 85.0%, preferably is equal to or greater than 88.0%, more preferably is equal to or greater than 90.0%, even more preferably is equal to or greater than 91.0%, and still more preferably is in a range from 91.5% to 95.0%; and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%, preferably is less than or equal to 3.0%, more preferably is less than or equal to 1.5%, even more preferably is less than or equal to 1.2%, and still more preferably is less than or equal to 0.5%; and/or a transmittance $T_{870\ nm}$ of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is less than or equal to 15.0%, preferably in a range from 0.1% to 12.5%, more preferably in a range from 0.1% to 10%, even more preferably in a range from 0.1% to 8.0%, and still more preferably in a range from 0.1% to 5.0%; and/or a transmittance $T_{940\ nm}$ of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is equal to or less than 50.0%, preferably in a range from 0.1% to 35.0%, more preferably in a range from 0.3% to 20.0%, even more preferably in a range from 0.3% to 15.0%, and still more preferably in a range from 0.3% to 10.0%.

[0072] (66) The microcrystalline glass according to any one of (34) to (65), wherein the thickness of the microcrystalline glass is in a range from 0.5 mm to 1.5 mm, preferably in a range from 0.8 mm to 1.2 mm, and more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0073] (67) A matrix glass includes the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%. The R_2O is one or both of Na_2O and K_2O.

[0074] (68) The matrix glass according to (67) further includes the following components in percentage by weight: Sb_2O_3: 0% to 1%; and/or SnO_2: 0% to 0.5%; and/or MO: 0% to 5%; and/or Ln_2O_3: 0% to 5%; and/or Fe_2O_3: 0% to 1%. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0075] (69) A matrix glass consists of the following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%, Sb_2O_3: 0% to 1%, SnO_2: 0% to 0.5%, MO: 0% to 5%, Ln_2O_3: 0% to 5%, and Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0076] (70) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: SiO_2/Li_2O is in a range from 5.5 to 10.0.

[0077] (71) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1.

[0078] (72) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0.

[0079] (73) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, ZrO_2, CeO_2, and Ag_2O. The R_2O is one or both of Na_2O and K_2O. The components in percentage by weight satisfy: Ag_2O/CeO_2 is in a range from 1.0 to 10.0.

[0080] (74) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. Young's modulus E of the matrix glass is in a range from 7000×10^7 Pa to 9500×10^7 Pa.

[0081] (75) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. A dielectric constant ε_r of the matrix glass is in a range from 5.5 to 8.5.

[0082] (76) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, Al_2O_3, and ZrO_2. The R_2O is one or both of Na_2O and K_2O. A Knoop hardness $Hk_{0.1}$ of the matrix glass is equal to or greater than 450 kgf/mm^2.

[0083] (77) A matrix glass includes the following components: SiO_2, R_2O, Li_2O, and ZrO_2. The R_2O is one or both of Na_2O and K_2O, and a coefficient of linear expansion $\alpha_{20°C\text{-}300°C}$ of the matrix glass is less than or equal to 100×10^{-7}/°C.

[0084] (78) The matrix glass according to any one of (70) to (77) includes the following components in percentage by weight: SiO_2: 65% to 78%, and/or R_2O: 2% to 12%, and/or Li_2O: 5% to 15%, and/or Al_2O_3: 3% to 12%, and/or ZrO_2: 1.5% to 10%, and/or CeO_2: 0.01% to 0.6%, and/or Ag_2O: 0.01% to 0.8%, and/or Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%. The R_2O is one or both of Na_2O and K_2O. The MO is one or more selected from the group consisting of

MgO, CaO, SrO, BaO, and ZnO. The Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0085] (79) The matrix glass according to any one of (67) to (78), wherein the components in percentage by weight satisfy: SiO_2/Li_2O is in a range from 5.5 to 10.0, preferably SiO_2/Li_2O is in a range from 6.0 to 9.0, and more preferably SiO_2/Li_2O is in a range from 7.0 to 8.5.

[0086] (80) The matrix glass according to any one of (67) to (79), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0, preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5, and more preferably $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6.

[0087] (81) The matrix glass according to any one of (67) to (80), wherein the components in percentage by weight satisfy: $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1, preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5, and more preferably $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5.

[0088] (82) The matrix glass according to any one of (67) to (81), wherein the components in percentage by weight satisfy: Ag_2O/CeO_2 is in a range from 1.0 to 10.0, preferably Ag_2O/CeO_2 is in a range from 1.5 to 6.5, and more preferably Ag_2O/CeO_2 is in a range from 2.0 to 4.5.

[0089] (83) The matrix glass according to any one of (67) to (82), wherein the components in percentage by weight satisfy: Li_2O/ZrO_2 is in a range from 1.0 to 7.5, preferably Li_2O/ZrO_2 is in a range from 1.2 to 5.0, more preferably Li_2O/ZrO_2 is in a range from 1.4 to 4.3, and even more preferably Li_2O/ZrO_2 is in a range from 1.6 to 3.0.

[0090] (84) The matrix glass according to any one of (67) to (83), wherein the components in percentage by weight satisfy: $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0, preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0, more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 12.0 to 25.0, and even more preferably $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0.

[0091] (85) The matrix glass according to any one of (67) to (84), wherein the components in percentage by weight satisfy: $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0, preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0, more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 8.5 to 20.0, and even more preferably $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0.

[0092] (86) The matrix glass according to any one of (67) to (85), wherein the components in percentage by weight satisfy: $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0, preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0, more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 5.0 to 12.5, and even more preferably $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0.

[0093] (87) The matrix glass according to any one of (67) to (86), wherein the components in percentage by weight satisfy: $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0, preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0, more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.7 to 3.7, and even more preferably $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2.

[0094] (88) The matrix glass according to any one of (67) to (87), wherein the components in percentage by weight satisfy: $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9, preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6, and more preferably $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5.

[0095] (89) The matrix glass according to any one of (67) to (88), wherein the components in percentage

by weight satisfy: $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%, preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%, more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 18.5% to 26%, and even more preferably $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%. The R_2O is one or both of Na_2O and K_2O.

[0096] (90) The matrix glass according to any one of (67) to (89), wherein the components in percentage by weight satisfy: $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5, preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5, more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.3 to 6.0, and even more preferably $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8.

[0097] (91) The matrix glass according to any one of (67) to (90), wherein the components in percentage by weight satisfy: MO/ZrO_2 is equal to or less than 2.5, preferably MO/ZrO_2 is equal to or less than 1.5, and more preferably MO/ZrO_2 is equal to or less than 0.5. The MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

[0098] (92) The matrix glass according to any one of (67) to (91), wherein the components in percentage by weight satisfy: $Sb_2O_3+SnO_2$: 0.05% to 1.2%, preferably $Sb_2O_3+SnO_2$: 0.1% to 1%, and more preferably $Sb_2O_3+SnO_2$: 0.2% to 0.7%.

[0099] (93) The matrix glass according to any one of (67) to (92) includes the following components in percentage by weight: SiO_2: 68% to 77%, preferably SiO_2: 69.5% to 75.5%; and/or R_2O: 3% to 10%, preferably R_2O: 4% to 8%; and/or Li_2O: 7% to 13%, preferably Li_2O: 8.5% to 12%; and/or Al_2O_3: 4% to 10%, preferably Al_2O_3: 5% to 9%; and/or ZrO_2: 2% to 8%, preferably ZrO_2: 3% to 6.5%; and/or CeO_2: 0.07% to 0.4%, preferably CeO_2: 0.08% to 0.3%; and/or Ag_2O: 0.1% to 0.6%, preferably Ag_2O: 0.2% to 0.5%; and/or Sb_2O_3: 0.01% to 0.7%, preferably Sb_2O_3: 0.07% to 0.5%; and/or SnO_2: 0% to 0.3%, preferably SnO_2: 0% to 0.2%; and/or MO: 0% to 3%, preferably MO: 0% to 1%, more preferably MO is not contained; and/or Ln_2O_3: 0% to 3%, preferably Ln_2O_3: 0% to 1%, more preferably Ln_2O_3 is not contained; and/or Fe_2O_3: 0% to 0.5%, preferably Fe_2O_3: 0% to 0.2%, more preferably Fe_2O_3 is not contained. The R_2O is one or both of Na_2O and K_2O, the MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and the Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

[0100] (94) The matrix glass according to any one of (67) to (93), wherein a refractive index n_d of the matrix glass is in a range from 1.51 to 1.55, preferably in a range from 1.52 to 1.54, more preferably in a range from 1.53 to 1.535, even more preferably in a range from 1.53112 to 1.53284; and/or Young's modulus E of the matrix glass is in a range from 7000×10^7 Pa to 9500×10^7 Pa, preferably in a range from 7500×10^7 Pa to 9200×10^7 Pa, more preferably in a range from 7836×10^7 Pa to 9014×10^7 Pa, even more preferably in a range from 8005×10^7 Pa to 8488×10^7 Pa; and/or Knoop hardness $Hk_{0.1}$ is greater than or equal to 450 kgf/mm^2, preferably in a range from 470 kgf/mm^2 to 600 kgf/mm^2, more preferably in a range from 480 kgf/mm^2 to 582 kgf/mm^2, even more preferably in a range from 492 kgf/mm^2 to 532 kgf/mm^2; and/or a drop ball test height I is greater than or equal to 200 mm, preferably greater than or equal to 300 mm, more preferably greater than or equal to 400 mm; and/or a dielectric loss tanδ is less than or equal to 11.0×10^{-3}, preferably in a range from 7.0×10^{-3} to 10.5×10^{-3}, more preferably in a range from 7.2×10^{-3} to 9.8×10^{-3}, even more preferably in a range from 7.4×10^{-3} to 9.2×10^{-3}; and/or a dielectric constant ε_r is in a range from 5.5 to 8.5, preferably in a range

from 6.0 to 8.0, more preferably in a range from 6.2 to 7.7, even more preferably in a range from 6.3 to 7.0; and/or a coefficient of linear expansion $\alpha_{20℃-300℃}$ is less than or equal to 100×10^{-7}/℃, preferably in a range from 65×10^{-7}/℃ to 100×10^{-7}/℃, more preferably in a range from 71×10^{-7}/℃ to 95×10^{-7}/℃, even more preferably in a range from 75×10^{-7}/℃ to 90×10^{-7}/℃.

[0101] (95) A glass cover plate includes the microcrystalline glass product according to any one of (1) to (33), and/or the microcrystalline glass according to any one of (34) to (66), and/or the matrix glass according to any one of (67) to (94).

[0102] (96) A glass element includes the microcrystalline glass product according to any one of (1) to (33), and/or the microcrystalline glass according to any one of (34) to (66), and/or the matrix glass according to any one of (67) to (94).

[0103] (97) A device includes the microcrystalline glass product according to any one of (1) to (33), and/or the microcrystalline glass according to any one of (34) to (66), and/or the matrix glass according to any one of (67) to (94), and/or the glass cover plate according to (95), and/or the glass element according to (96).

[0104] (98) A method for manufacturing the microcrystalline glass product according to any one of (1) to (33) includes the following steps: forming a matrix glass, subjecting the matrix glass to a crystallization process to form a microcrystalline glass, and then subjecting the microcrystalline glass to a chemical strengthening process to yield a microcrystalline glass product.

[0105] (99) The method according to (98), wherein the crystallization process includes subjecting the matrix glass to a mask exposure treatment and subsequently to a crystallization heat treatment. The mask exposure treatment includes exposing a specific position or region of the matrix glass to ultraviolet light. Preferably, the ultraviolet light has a wavelength of 313 nm. Preferably, an exposure duration ranges from 5 minutes to 60 minutes.

[0106] (100) The method according to (98) or (99), wherein the crystallization heat treatment is carried out in two stages, the two-stage crystallization heat treatment includes performing a nucleation process at a first temperature and then performing a crystal growth process at a second temperature higher than the nucleation process temperature. Preferably, the first temperature is in a range from 490 °C to 520 °C. The treatment duration at the first temperature is preferably in a range from 1 hour to 4 hours. The second temperature is preferably in a range from 540 °C to 620 °C. The treatment duration at the second temperature is preferably in a range from 1 hour to 8 hours.

[0107] (101) The method according to any one of (98) to (100), wherein the chemical strengthening process includes immersing the microcrystalline glass in a salt bath of a molten Na salt, and/or a molten K salt, and/or a molten Na and K mixed salt at a temperature of 350 °C to 470 °C for about 1 hour to 36 hours. The temperature is preferably in a range from 380 °C to 460 °C. The time period is preferably in a range from 2 hours to 24 hours.

[0108] (102) A method for manufacturing the microcrystalline glass according to any one of (34) to (66) includes the following steps: forming a matrix glass and subjecting the matrix glass to the crystallization process to yield the microcrystalline glass.

[0109] (103) The method according to (102), wherein the crystallization process includes subjecting the

matrix glass to a mask exposure treatment and subsequently to a crystallization heat treatment. The mask exposure treatment includes exposing a specific position or region of the matrix glass to ultraviolet light. Preferably, the ultraviolet light has a wavelength of 313 nm. Preferably, an exposure duration ranges from 5 minutes to 60 minutes.

[0110] (104) The method according to (102) or (103), wherein the crystallization heat treatment is carried out in two stages, the two-stage crystallization heat treatment includes performing a nucleation process at a first temperature and then performing a crystal growth process at a second temperature higher than the nucleation process temperature. Preferably, the first temperature is in a range from 490 °C to 520 °C. The treatment duration at the first temperature is preferably in a range from 1 hour to 4 hours. The second temperature is preferably in a range from 540 °C to 620 °C. The treatment duration at the second temperature is preferably in a range from 1 hour to 8 hours.

[0111] The beneficial effects of the present application are as follows: Through appropriate component design, the matrix glass of the present application can be crystallized to form a microcrystalline glass having a blackened portion and a transparent portion. The microcrystalline glass obtained by the present application is suitable for chemical strengthening. The microcrystalline glass and the microcrystalline glass product made therefrom exhibit excellent mechanical properties. In some embodiments, the microcrystalline glass or microcrystalline glass product of the present application has a blackened portion and a transparent portion. The transparent portion exhibits high transmittance in the visible light wavelength range, while the blackened portion exhibits low transmittance in the visible light wavelength range.

DETAILED DESCRIPTION

[0112] Embodiments of the present application are described in detail below, but the present application is not limited to these embodiments. Appropriate modifications can be made within the scope of the objectives of the present application for implementation. In addition, some descriptions may be appropriately omitted to avoid repetition, this is not intended to limit the spirit of the present application.

[0113] The microcrystalline glass and microcrystalline glass product of the present application are materials having a crystalline phase (sometimes referred to as a crystal) and a glass phase, which are different from amorphous solids. The crystalline phase of the microcrystalline glass and microcrystalline glass product can be identified by a peak at an angle in the X-ray diffraction pattern of X-ray diffraction analysis and/or detected by the transmission electron microscopy and energy dispersive x-ray spectroscopy (TEM-EDX).

[0114] Based on repeated experiments and research, the inventors of the present application have found that the microcrystalline glass or microcrystalline glass product of the present application can be obtained by setting the contents and proportions of specific components constituting the microcrystalline glass or microcrystalline glass product to specific values thereby precipitating specific crystalline phases.

[0115] In some embodiments, the microcrystalline glass of the present application includes one or more blackened portions and one or more transparent portions. The transparent portion refers to, when the microcrystalline glass is processed to a thickness of 0.2 mm 1.5 mm, a portion of the microcrystalline glass whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is greater than or equal to 85.0%. The blackened portion refers to, when the microcrystalline glass is processed to a thickness of 0.2

mm 1.5 mm, a portion of the microcrystalline glass whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%. In some embodiments, the blackened portion of the microcrystalline glass contains the crystalline phase, while the transparent portion of the microcrystalline glass contains no crystalline phase. In some embodiments, the crystalline phase in the blackened portion of the microcrystalline glass is uniformly distributed.

[0116] In some embodiments, the microcrystalline glass product of the present application includes one or more blackened portions and one or more transparent portions. The transparent portion refers to, when the microcrystalline glass product is processed to a thickness of 0.2 mm 1.5 mm, a portion of the microcrystalline glass product whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is greater than or equal to 85.0%. The blackened portion refers to, when the microcrystalline glass product is processed to a thickness of 0.2 mm 1.5 mm, a portion of the microcrystalline glass product whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%. In some embodiments, the blackened portion of the microcrystalline glass product contains the crystalline phase, while the transparent portion of the microcrystalline glass product contains no crystalline phase. In some embodiments, the crystalline phase in the blackened portion of the microcrystalline glass product is uniformly distributed.

[0117] In some embodiments, the microcrystalline glass or microcrystalline glass product of the present application as a whole is a blackened portion. The blackened portion refers to, when the microcrystalline glass or the microcrystalline glass product is processed to a thickness of 0.2 mm 1.5 mm, a portion of the microcrystalline glass or the microcrystalline glass product whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%. In some embodiments, the crystalline phase in the blackened portion of the microcrystalline glass or microcrystalline glass product is uniformly distributed.

[0118] In some embodiments, the microcrystalline glass or the microcrystalline glass product of the present application as a whole is a transparent portion. The transparent portion refers to, when the microcrystalline glass or the microcrystalline glass product is processed to a thickness of 0.2 mm 1.5 mm, a portion of the microcrystalline glass or the microcrystalline glass product whose average transmittance ($T_{400\text{-}800nm}$) in a wavelength range from 400 nm to 800 nm is greater than or equal to 85.0%.

[0119] In some embodiments, the blackened portion in the microcrystalline glass or the microcrystalline glass product of the present application can be patterned into any shape and/or size.

[0120] The contents of components (constituents) of the matrix glass, microcrystalline glass, and microcrystalline glass product of the present application will be described below. In the present specification, unless otherwise specified, the content of each component is expressed as a weight percentage (wt%) based on the total weight of the matrix glass, microcrystalline glass, or microcrystalline glass product whose composition is converted into oxides. Here, the expression "composition … converted into oxides" means that, when raw materials of the components of the matrix glass, microcrystalline glass, or microcrystalline glass product of the present application, in forms of oxides, composite salts, hydroxides, etc., decompose and are converted into oxides upon melting, the total weight of these oxides is taken as 100%. Furthermore, in the present specification, when referred to simply as "glass", it refers to the matrix glass before crystallization (i.e.,

a crystallization process). After the matrix glass is subjected to the crystallization (i.e., the crystallization process), it is called “microcrystalline glass”. The term “microcrystalline glass product” refers to the product obtained by chemically strengthening the microcrystalline glass.

[0121] Unless otherwise indicated in specific circumstances, the numerical ranges listed herein include the upper and lower limits, while “above” and “below” include the endpoint values, and include all integers and fractions within the ranges rather than limited to the specific values listed when defining the ranges. The term “about” as used herein means that the formulations, parameters, and other quantities as well as characteristics are not, and need not be, exact, and may be approximate and/or larger or smaller as needed, reflecting tolerances, conversion factors, measurement errors, etc. The term “and/or” as used herein is inclusive, for example, “A and/or B” means that only A, or only B, or both A and B are present. The terms “preferably”, “more preferably”, “still more preferably”, etc., in the present application are merely used for describing specific embodiments or examples having good effects. However, the description of the embodiments or examples using these terms does not imply that other embodiments or examples are not viable, nor is it intended to exclude other embodiments or examples from the scope of the present application.

[0122] In some embodiments of the present application, the crystalline phase (crystal) in the microcrystalline glass or microcrystalline glass product contains a lithium silicate crystalline phase, preferably a lithium metasilicate (Li_2SiO_3) crystalline phase. In some embodiments, the lithium metasilicate crystalline phase has a greater weight percentage than other crystalline phases. In some embodiments, the crystalline phase in the microcrystalline glass or microcrystalline glass product includes only the lithium metasilicate crystalline phase.

[0123] In some embodiments, in the blackened portion of the microcrystalline glass or microcrystalline glass product, the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50%, preferably from 5% to 40%, and more preferably from 10% to 30%. In some embodiments, the weight percentage of the lithium metasilicate crystalline phase in the blackened portion of the microcrystalline glass or microcrystalline glass product is 5%, 6%, 7%, 8%, 9%, 10%, 11%, 12%, 13%, 14%, 15%, 16%, 17%, 18%, 19%, 20%, 21%, 22%, 23%, 24%, 25%, 26%, 27%, 28%, 29%, 30%, 31%, 32%, 33%, 34%, 35%, 36%, 37%, 38%, 39%, 40%, 41%, 42%, 43%, 44%, 45%, 46%, 47%, 48%, 49%, or 50%.

[0124] SiO_2 is a glass-forming oxide, forming the skeleton of the glass, and has a relatively low dielectric constant and dielectric loss. SiO_2 is a constituent component of lithium metasilicate in microcrystalline glass. When the SiO_2 content is less than 65%, the hardness and expansion coefficient of the glass decrease, while the dielectric constant and dielectric loss of the glass increase. When the SiO_2 content is greater than 78%, the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product increases. Therefore, the SiO_2 content ranges from 65% to 78%, preferably from 68% to 77%, and more preferably from 69.5% to 75.5%. In some embodiments, SiO_2 may be contained at approximately 65%, 65.5%, 66%, 66.5%, 67%, 67.5%, 68%, 68.5%, 69%, 69.5%, 70%, 70.5%, 71%, 71.5%, 72%, 72.5%, 73%, 73.5%, 74%, 74.5%, 75%, 75.5%, 76%, 76.5%, 77%, 77.5%, or 78%.

[0125] Li_2O is the main component for forming crystals in the microcrystalline glass and microcrystalline glass product of the present application. When the Li_2O content is less than 5%, the crystal content of the

microcrystalline glass or microcrystalline glass product decreases, and the transmittance of the blackened portion is relatively high. When the Li_2O content is greater than 15%, the Young's modulus and ball drop test height of the glass decrease, while the refractive index and dielectric loss of the glass increase, and meanwhile the non-UV-exposed portion of the matrix glass during the crystallization process is prone to crystallization during heat treatment, resulting in reduced transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product. Therefore, the Li_2O content is defined in a range from 5% to 15%, preferably from 7% to 13%, and more preferably from 8.5% to 12%. In some embodiments, Li_2O may be contained at approximately 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, 10%, 10.5%, 11%, 11.5%, 12%, 12.5%, 13%, 13.5%, 14%, 14.5%, or 15%.

[0126] The inventors have found through research that in some embodiments, the hardness and ball drop test height of the glass increase as the SiO_2/Li_2O value increases, while the refractive index decreases as the SiO_2/Li_2O value increases. Furthermore, when SiO_2/Li_2O is less than 5.5, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product decreases, and the transmittance of the blackened portion increases. When SiO_2/Li_2O exceeds 10.0, the crystal content of the blackened portion of the microcrystalline glass and microcrystalline glass product is relatively low, and the transmittance of the blackened portion increases. Therefore, in some embodiments, SiO_2/Li_2O is preferably in a range from 5.5 to 10.0, more preferably from 6.0 to 9.0, and even more preferably from 7.0 to 8.5, and the transparent portion of the microcrystalline glass and microcrystalline glass product has high transmittance in the visible light range, and the blackened portion has relatively low transmittance, which is particularly suitable for optical signal channels or light shielding systems of electronic products. In some embodiments, the value of SiO_2/Li_2O can be 5.5, 5.6, 5.7, 5.8, 5.9, 6.0, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 8.0, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, 9.0, 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 9.9, or 10.0.

[0127] Alkali metal oxides R_2O, (where R_2O is one or both of Na_2O and K_2O) can promote the precipitation of lithium metasilicate crystals and improve the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product. When the R_2O content is less than 2%, the crystal content of the microcrystalline glass and microcrystalline glass product decreases, and the transmittance of the blackened portion increases, or even the blackening effect cannot be achieved. When the R_2O content is greater than 12%, the Young's modulus and ball drop test height of the glass decrease, and the refractive index, dielectric constant, and dielectric loss of the glass increase. Therefore, the content of R_2O is defined in a range from 2% to 12%, preferably 3% to 10%, and more preferably 4% to 8%. In some embodiments, R_2O can be contained at approximately 2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, 10%, 10.5%, 11%, 11.5%, or 12%.

[0128] Al_2O_3 can suppress the decrease in transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product after mask exposure and heat treatment, and can improve the strength and hardness of the glass and enhance the chemical stability of the glass. When the Al_2O_3 content is less than 3%, the hardness and Young's modulus of the glass decrease and the coefficient of linear expansion increases. When the Al_2O_3 content is greater than 12%, the dielectric constant and dielectric loss of the glass increase, the crystal content of the blackened portion of the microcrystalline glass and microcrystalline glass product

decreases, and the transmittance of the blackened portion increases, or even the blackening effect cannot be achieved. Therefore, the content of Al_2O_3 is defined in a range from 3% to 12%, preferably from 4% to 10%, and more preferably from 5% to 9%. In some embodiments, Al_2O_3 may be contained at approximately 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, 10%, 10.5%, 11%, 11.5%, or 12%.

[0129] In some embodiments, when the total content of R_2O, Li_2O, and Al_2O_3, i.e., $R_2O+Li_2O+Al_2O_3$, is less than 15%, the refractive index, hardness and Young's modulus of the glass decrease. When $R_2O+Li_2O+Al_2O_3$ is greater than 30%, the dielectric constant and dielectric loss of the glass increase. Therefore, $R_2O+Li_2O+Al_2O_3$ is preferably in a range from 15% to 30%, more preferably from 17.5% to 29.5%, even more preferably from 18.5% to 26%, and still more preferably from 20% to 25%. In some embodiments, $R_2O+Li_2O+Al_2O_3$ is approximately 15%, 15.5%, 16%, 16.5%, 17%, 17.5%, 18%, 18.5%, 19%, 19.5%, 20%, 20.5%, 21%, 21.5%, 22%, 22.5%, 23%, 23.5%, 24%, 24.5%, 25%, 25.5%, 26%, 26.5%, 27%, 27.5%, 28%, 28.5%, 29%, 29.5%, or 30%.

[0130] The inventors have found through extensive experimental research that in some embodiments, when the ratio of the total content of SiO_2 and Al_2O_3 to the total content of Li_2O, Na_2O and K_2O, i.e., $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$, is in a range from 3.0 to 7.5, the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product is even lower, and the refractive index of the glass is relatively low, which can reduce the reflectivity of optical signals on the glass surface and improve the incidence rate of optical signals. Therefore, $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is preferably in a range from 3.0 to 7.5, more preferably from 3.7 to 6.5, even more preferably from 4.3 to 6.0, and still more preferably from 4.8 to 5.8. In some embodiments, the value of $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ can be 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6.0, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.1, 7.2, 7.3, 7.4, or 7.5.

[0131] ZrO_2 can adjust the precision of black pattern formation in the blackened portion of the glass after mask exposure, improve the interface distinction between the exposed and unexposed portions, and prevent crystallization of the unexposed portion near the interface during heat treatment, thereby maintaining high transmittance of the unexposed portion in the visible light range after heat treatment, while ensuring relatively low transmittance of the blackened portion after heat treatment of the exposed portion. When the ZrO_2 content is less than 1.5%, the expansion coefficient of the glass increases, and the unexposed portion is prone to crystallization during heat treatment, resulting in reduced transmittance of the transparent portion. When the ZrO_2 content is greater than 10%, the crystal content of the microcrystalline glass and microcrystalline glass product decreases, and the transmittance of the blackened portion increases, or even the blackening effect cannot be achieved. Therefore, the content of ZrO_2 is in a range from 1.5% to 10%, preferably from 2% to 8%, and more preferably from 3% to 6.5%. In some embodiments, ZrO_2 can be contained at approximately 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 4.5%, 5%, 5.5%, 6%, 6.5%, 7%, 7.5%, 8%, 8.5%, 9%, 9.5%, or 10%.

[0132] In some embodiments, when the ratio of the total content of K_2O and Na_2O to the content of ZrO_2, i.e., $(K_2O+Na_2O)/ZrO_2$, is in a range from 0.5 to 7.1, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product is relatively high, the hardness and Young's modulus of the glass are relatively high, and the dielectric constant of the glass is relatively low. Therefore,

$(K_2O+Na_2O)/ZrO_2$ is preferably in a range from 0.5 to 7.1, more preferably from 0.7 to 4.5, and even more preferably from 0.8 to 2.5. In some embodiments, the value of $(K_2O+Na_2O)/ZrO_2$ can be 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 6.0, 6.5, 7.0, or 7.1.

[0133] In some embodiments, when the ratio of the Li_2O content to the ZrO_2 content, i.e., Li_2O/ZrO_2, is in a range from 1.0 to 7.5, the glass can have a relatively low refractive index and dielectric loss, the precision of pattern formation in the microcrystalline glass and microcrystalline glass product after mask exposure and heat treatment can be improved, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product is relatively high, and the transmittance of the blackened portion is relatively low. Therefore, Li_2O/ZrO_2 is preferably in a range from 1.0 to 7.5, more preferably from 1.2 to 5.0, even more preferably from 1.4 to 4.3, and still more preferably from 1.6 to 3.0. In some embodiments, the value of Li_2O/ZrO_2 may be 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.5, 6.0, 6.5, 7.0, or 7.5.

[0134] In some embodiments, when the ratio of the total content of SiO_2 and Li_2O to the ZrO_2 content, i.e., $(SiO_2+Li_2O)/ZrO_2$, is in a range from 8.0 to 55.0, the hardness and ball drop test height of the glass can be improved, the expansion coefficient and dielectric constant of the glass can be reduced, the precision of pattern formation in the microcrystalline glass and microcrystalline glass product after mask exposure and heat treatment can be improved, and the ball drop test height of the microcrystalline glass and microcrystalline glass product can be improved, while the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product is relatively low. Therefore, $(SiO_2+Li_2O)/ZrO_2$ is preferably in a range from 8.0 to 55.0, more preferably from 10.0 to 37.0, even more preferably from 12.0 to 25.0, and still more preferably from 13.0 to 20.0. In some embodiments, the value of $(SiO_2+Li_2O)/ZrO_2$ can be 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5, 31.0, 31.5, 32.0, 32.5, 33.0, 33.5, 34.0, 34.5, 35.0, 35.5, 36.0, 36.5, 37.0, 38.0, 39.0, 40.0, 41.0, 42.0, 43.0, 44.0, 45.0, 46.0, 47.0, 48.0, 49.0, 50.0, 51.0, 52.0, 53.0, 54.0, or 55.0.

[0135] Alkaline earth metal oxide MO can improve the dielectric constant of the glass and improve the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product, wherein the MO is one or more of MgO, CaO, SrO, BaO, or ZnO. When the MO content exceeds 5%, the dielectric constant and dielectric loss of the glass increase, and the Young's modulus and ball drop test height of the glass decrease. Therefore, the content of MO in the present application is defined in a range from 0% to 5%, preferably from 0% to 3%, more preferably from 0% to 1%, and even more preferably the MO is not contained. In some embodiments, MO can be contained at approximately 0%, greater than 0%, 0.01%, 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1%, 1.1%, 1.2%, 1.3%, 1.4%, 1.5%, 1.6%, 1.7%, 1.8%, 1.9%, 2%, 2.1%, 2.2%, 2.3%, 2.4%, 2.5%, 2.6%, 2.7%, 2.8%, 2.9%, 3%, 3.1%, 3.2%, 3.3%, 3.4%, 3.5%, 3.6%, 3.7%, 3.8%, 3.9%, 4%, 4.1%, 4.2%, 4.3%, 4.4%, 4.5%, 4.6%, 4.7%, 4.8%, 4.9%, or 5%.

[0136] In some embodiments, when MO/ZrO_2 is greater than 2.5, the dielectric loss of the glass increases,

the hardness, Young's modulus and ball drop test height of the glass decrease, and the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product increases. Therefore, MO/ZrO_2 is preferably less than or equal to 2.5, more preferably less than or equal to 1.5, and even more preferably less than or equal to 0.5. In some embodiments, the value of MO/ZrO_2 can be 0, greater than 0, 0.01, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, or 2.5.

[0137] CeO_2 is a photosensitizer that provides electrons to components such as Ag, Sb, and Sn. When the CeO_2 content is less than 0.01%, insufficient electrons are provided, resulting in excessively low crystal content of the microcrystalline glass, reduced transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product, and reduced Young's modulus of the microcrystalline glass and microcrystalline glass product. When the CeO_2 content is greater than 0.6%, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product decreases, and the penetration depth of ultraviolet light in the microcrystalline glass and microcrystalline glass product decreases, resulting in reduced crystal content inside the blackened portion of the microcrystalline glass and microcrystalline glass product and increased transmittance. Therefore, the CeO_2 content is in a range from 0.01% to 0.6%, preferably from 0.07% to 0.4%, and more preferably from 0.08% to 0.3%. In some embodiments, CeO_2 can be contained at approximately 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.11%, 0.12%, 0.13%, 0.14%, 0.15%, 0.16%, 0.17%, 0.18%, 0.19%, 0.2%, 0.21%, 0.22%, 0.23%, 0.24%, 0.25%, 0.26%, 0.27%, 0.28%, 0.29%, 0.3%, 0.31%, 0.32%, 0.33%, 0.34%, 0.35%, 0.36%, 0.37%, 0.38%, 0.39%, 0.4%, 0.41%, 0.42%, 0.43%, 0.44%, 0.45%, 0.46%, 0.47%, 0.48%, 0.49%, 0.5%, 0.51%, 0.52%, 0.53%, 0.54%, 0.55%, 0.56%, 0.57%, 0.58%, 0.59%, or 0.6%.

[0138] Ag_2O, as a nucleating agent for the microcrystalline glass and microcrystalline glass product of the present application, plays a role in improving the blackening effect in the microcrystalline glass and microcrystalline glass product. When the Ag_2O content is less than 0.01%, the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product increases, or even blackening cannot be achieved, and the ball drop test height of the microcrystalline glass and microcrystalline glass product decreases, the expansion coefficient increases, and the pattern precision decreases. When the Ag_2O content exceeds 0.8%, the transmittance of the transparent portion of the glass decreases during glass molding or heat treatment, and due to excessive nuclei content, the number of crystals in the microcrystalline glass and microcrystalline glass product increases, resulting in excessively fine grain size, weakening the scattering effect of the crystals in the blackened portion on visible light, which easily leads to increased transmittance of the blackened portion, and the glass is prone to crystallization during molding. Therefore, the content of Ag_2O is defined in a range from 0.01% to 0.8%, preferably from 0.1% to 0.6%, and more preferably from 0.2% to 0.5%. In some embodiments, Ag_2O can be contained at approximately 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.11%, 0.12%, 0.13%, 0.14%, 0.15%, 0.16%, 0.17%, 0.18%, 0.19%, 0.2%, 0.21%, 0.22%, 0.23%, 0.24%, 0.25%, 0.26%, 0.27%, 0.28%, 0.29%, 0.3%, 0.31%, 0.32%, 0.33%, 0.34%, 0.35%, 0.36%, 0.37%, 0.38%, 0.39%, 0.4%, 0.41%, 0.42%, 0.43%, 0.44%, 0.45%, 0.46%, 0.47%, 0.48%, 0.49%, 0.5%, 0.51%, 0.52%, 0.53%, 0.54%, 0.55%, 0.56%, 0.57%, 0.58%, 0.59%, 0.6%, 0.61%,

0.62%, 0.63%, 0.64%, 0.65%, 0.66%, 0.67%, 0.68%, 0.69%, 0.7%, 0.71%, 0.72%, 0.73%, 0.74%, 0.75%, 0.76%, 0.77%, 0.78%, 0.79%, or 0.8%.

[0139] The inventors have found through research that in some embodiments, when the ratio of the Ag_2O content to the CeO_2 content, i.e., Ag_2O/CeO_2, is in a range from 1.0 to 10.0, the grain size of the blackened portion of the microcrystalline glass and microcrystalline glass product is relatively large, the crystal content is relatively high, the scattering effect on visible light is relatively strong, the transmittance of the blackened portion is relatively low, and the hardness and ball drop test height of the microcrystalline glass and microcrystalline glass product increase. Therefore, Ag_2O/CeO_2 is preferably in a range from 1.0 to 10.0, more preferably from 1.5 to 6.5, and even more preferably from 2.0 to 4.5. In some embodiments, the value of Ag_2O/CeO_2 can be 1.0, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, or 10.0.

[0140] In some embodiments, when the ratio of the ZrO_2 content to the total content of Ag_2O and CeO_2, i.e., $ZrO_2/(Ag_2O+CeO_2)$, is in a range from 2.3 to 50.0, the expansion coefficient of the glass can be optimized, the precision of pattern formation in the microcrystalline glass after mask exposure and heat treatment can be improved, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product is relatively high, the transmittance of the blackened portion is relatively low, and the hardness and ball drop height of the glass and microcrystalline glass product can be increased. Therefore, $ZrO_2/(Ag_2O+CeO_2)$ is preferably in a range from 2.3 to 50.0, more preferably from 6.5 to 35.0, even more preferably from 8.5 to 20.0, and still more preferably from 11.0 to 18.0. In some embodiments, the value of $ZrO_2/(Ag_2O+CeO_2)$ can be 2.3, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 26.0, 27.0, 28.0, 29.0, 30.0, 31.0, 32.0, 33.0, 34.0, 35.0, 36.0, 37.0, 38.0, 39.0, 40.0, 41.0, 42.0, 43.0, 44.0, 45.0, 46.0, 47.0, 48.0, 49.0, or 50.0.

[0141] Sb_2O_3 and SnO_2 absorb electrons released by Ce^{3+} during ultraviolet exposure, serving to store electrons and provide electrons for Ag^+ in the subsequent heat treatment process, thereby forming Ag colloid nuclei and promoting blackening of the microcrystalline glass. When the content of $Sb_2O_3+SnO_2$ is less than 0.05%, it is difficult for the microcrystalline glass or microcrystalline glass product to achieve the blackening effect. When the content of $Sb_2O_3+SnO_2$ is greater than 1.2%, the transmittance of the blackened portion of the microcrystalline glass or microcrystalline glass product tends to increase. Therefore, the content of $Sb_2O_3+SnO_2$ is in a range from 0.05% to 1.2%, preferably from 0.1% to 1%, and more preferably from 0.2% to 0.7%. In some embodiments, the content of $Sb_2O_3+SnO_2$ is approximately 0.05%, 0.1%, 0.15%, 0.2%, 0.25%, 0.3%, 0.35%, 0.4%, 0.45%, 0.5%, 0.55%, 0.6%, 0.65%, 0.7%, 0.75%, 0.8%, 0.85%, 0.9%, 0.95%, 1.0%, 1.05%, 1.1%, 1.15%, or 1.2%.

[0142] SnO_2 has a good effect in promoting blackening of the microcrystalline glass, but in some embodiments, when the SnO_2 content is greater than 0.5%, the transmittance of the transparent portion of the glass decreases or even devitrification occurs during molding or heat treatment. Therefore, the content of SnO_2 is defined in a range from 0% to 0.5%, preferably from 0% to 0.3%, and more preferably from 0% to 0.2%.

The content of Sb_2O_3 is defined in a range from 0% to 1%, preferably from 0.01% to 0.7%, and more preferably from 0.07% to 0.5%. In some embodiments, SnO_2 can be contained at approximately 0%, greater than 0%, 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.11%, 0.12%, 0.13%, 0.14%, 0.15%, 0.16%, 0.17%, 0.18%, 0.19%, 0.2%, 0.21%, 0.22%, 0.23%, 0.24%, 0.25%, 0.26%, 0.27%, 0.28%, 0.29%, 0.3%, 0.31%, 0.32%, 0.33%, 0.34%, 0.35%, 0.36%, 0.37%, 0.38%, 0.39%, 0.4%, 0.41%, 0.42%, 0.43%, 0.44%, 0.45%, 0.46%, 0.47%, 0.48%, 0.49%, or 0.5%. In some embodiments, Sb_2O_3 can be contained at approximately 0%, greater than 0%, 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.11%, 0.12%, 0.13%, 0.14%, 0.15%, 0.16%, 0.17%, 0.18%, 0.19%, 0.2%, 0.21%, 0.22%, 0.23%, 0.24%, 0.25%, 0.26%, 0.27%, 0.28%, 0.29%, 0.3%, 0.31%, 0.32%, 0.33%, 0.34%, 0.35%, 0.36%, 0.37%, 0.38%, 0.39%, 0.4%, 0.41%, 0.42%, 0.43%, 0.44%, 0.45%, 0.46%, 0.47%, 0.48%, 0.49%, 0.5%, 0.55%, 0.6%, 0.65%, 0.7%, 0.75%, 0.8%, 0.85%, 0.9%, 0.95%, or 1%.

[0143] The inventors have found through extensive experimental research that in some embodiments, when the ratio of the total content of Sb_2O_3 and SnO_2 (to the Ag_2O content, i.e., $(Sb_2O_3+SnO_2)/Ag_2O$, is in a range from 0.1 to 5.0, the dielectric loss of the glass can be reduced, the ball drop test height of the glass and microcrystalline glass product can be increased, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product is relatively high, and the transmittance of the blackened portion is relatively low. Therefore, $(Sb_2O_3+SnO_2)/Ag_2O$ is preferably in a range from 0.1 to 5.0, more preferably from 0.5 to 3.5, and even more preferably from 1.0 to 2.6. In some embodiments, the value of $(Sb_2O_3+SnO_2)/Ag_2O$ can be 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, or 5.0.

[0144] In some embodiments, when the ratio of the total content of Ag_2O, SnO_2, and Sb_2O_3 to the CeO_2 content, i.e., $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$, is in a range from 1.0 to 30.0, the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product is relatively low, and the hardness and Young's modulus can be improved while reducing the dielectric constant of the glass. Therefore, $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is preferably in a range from 1.0 to 30.0, more preferably from 3.0 to 20.0, even more preferably from 5.0 to 12.5, and still more preferably from 7.5 to 10.0. In some embodiments, the value of $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ may be 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0, 16.5, 17.0, 17.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, or 30.0.

[0145] In some embodiments, when the ratio of the total content of Sb_2O_3, SnO_2, and CeO_2 to the content of Ag_2O, i.e., $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$, is in a range from 0.1 to 10.0, the dielectric loss and expansion coefficient of the glass can be reduced, and the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product is relatively low. Therefore, $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is preferably in a range from 0.1 to 10.0, more preferably from 0.4 to 5.0, even more preferably from 0.7 to 3.7, and still more preferably from 1.5 to 3.2. In some embodiments, the value of $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ can be 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2.0, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6,

2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 4.0, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 5.0, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 6.0, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 7.0, 7.5, 8.0, 8.5, 9.0, 9.5, or 10.0.

[0146] In some embodiments, when the value of $SnO_2/(CeO_2+SnO_2)$ is greater than 0.9, the transmittance of the transparent portion of the glass decreases sharply or even completely devitrifies during glass molding or heat treatment. Therefore, $SnO_2/(CeO_2+SnO_2)$ is preferably in a range from 0 to 0.9, more preferably from 0 to 0.6, and even more preferably from 0 to 0.5. In some embodiments, the value of $SnO_2/(CeO_2+SnO_2)$ can be 0, greater than 0, 0.01, 0.02, 0.03, 0.04, 0.05, 0.07, 0.1, 0.13, 0.15, 0.17, 0.2, 0.23, 0.25, 0.27, 0.3, 0.33, 0.35, 0.37, 0.4, 0.43, 0.45, 0.47, 0.5, 0.53, 0.55, 0.57, 0.6, 0.63, 0.65, 0.67, 0.7, 0.73, 0.75, 0.77, 0.8, 0.83, 0.85, 0.87, or 0.9.

[0147] Ln_2O_3 can adjust the dielectric constant and dielectric loss of the glass and can provide electrons for Ag^+ to promote blackening of the microcrystalline glass, wherein Ln_2O_3 is one or more of La_2O_3, Gd_2O_3, or Y_2O_3. When Ln_2O_3 is greater than 5%, the transmittance of the blackened portion of the microcrystalline glass and microcrystalline glass product increases, and the dielectric constant and dielectric loss of the glass increase. Therefore, the content of Ln_2O_3 is defined in a range from 0% to 5%, preferably from 0% to 3%, more preferably from 0% to 1%, and in some embodiments, even more preferably Ln_2O_3 is not contained. In some embodiments, Ln_2O_3 can be contained at approximately 0%, greater than 0%, 0.01%, 0.05%, 0.1%, 0.2%, 0.3%, 0.4%, 0.5%, 0.6%, 0.7%, 0.8%, 0.9%, 1%, 1.1%, 1.2%, 1.3%, 1.4%, 1.5%, 1.6%, 1.7%, 1.8%, 1.9%, 2%, 2.1%, 2.2%, 2.3%, 2.4%, 2.5%, 2.6%, 2.7%, 2.8%, 2.9%, 3%, 3.1%, 3.2%, 3.3%, 3.4%, 3.5%, 3.6%, 3.7%, 3.8%, 3.9%, 4%, 4.1%, 4.2%, 4.3%, 4.4%, 4.5%, 4.6%, 4.7%, 4.8%, 4.9%, or 5%.

[0148] Fe_2O_3 can absorb ultraviolet light during ultraviolet exposure of the glass and can provide electrons for Ag^+ to promote blackening of the microcrystalline glass. When the Fe_2O_3 content is greater than 1%, the transmittance of the transparent portion of the microcrystalline glass and microcrystalline glass product in the visible light range decreases, the transmittance of the blackened portion increases, and the ball drop test height of the microcrystalline glass and microcrystalline glass product decreases. Therefore, the content of Fe_2O_3 is defined in a range from 0% to 1%, preferably from 0% to 0.5%, and more preferably from 0% to 0.2%. In some embodiments, even more preferably Fe_2O_3 is not contained. In some embodiments, Fe_2O_3 can be contained at approximately 0%, greater than 0%, 0.01%, 0.02%, 0.03%, 0.04%, 0.05%, 0.06%, 0.07%, 0.08%, 0.09%, 0.1%, 0.11%, 0.12%, 0.13%, 0.14%, 0.15%, 0.16%, 0.17%, 0.18%, 0.19%, 0.2%, 0.21%, 0.22%, 0.23%, 0.24%, 0.25%, 0.26%, 0.27%, 0.28%, 0.29%, 0.3%, 0.31%, 0.32%, 0.33%, 0.34%, 0.35%, 0.36%, 0.37%, 0.38%, 0.39%, 0.4%, 0.41%, 0.42%, 0.43%, 0.44%, 0.45%, 0.46%, 0.47%, 0.48%, 0.49%, 0.5%, 0.55%, 0.6%, 0.65%, 0.7%, 0.75%, 0.8%, 0.85%, 0.9%, 0.95%, or 1%.

[0149] The terms “not contained” and “0%” as used herein mean that the compound, molecule, or element, etc., is not intentionally added as a raw material to the matrix glass, the microcrystalline glass, or the microcrystalline glass product of the present application. However, due to the raw materials and/or equipment used in the production of the matrix glass, the microcrystalline glass, or the microcrystalline glass product, certain impurities or components that are not intentionally added may be present in small or trace amounts in the final matrix glass, microcrystalline glass, or microcrystalline glass product. The matrix glass, the

microcrystalline glass, or the microcrystalline glass product in such circumstances shall fall within the protection scope of the present application.

[0150] The various performance indicators of the matrix glass, microcrystalline glass and microcrystalline glass product of the present application were tested by the following methods:

[0151] <Light Transmittance>

[0152] Light transmittance was tested according to the following method: the sample to be tested was processed to a certain thickness and polished on opposite surfaces in parallel, and tested according to China National Standard *GB/T 7962.12-2010*.

[0153] <Coefficient of Linear Expansion>

[0154] The coefficient of linear expansion ($\alpha_{20°C\text{-}300°C}$) at the temperature of 20 °C to 300 °C was tested according to China National Standard *GB/T 7962.16-2010*. In the present application, the coefficient of linear expansion is sometimes referred to as the expansion coefficient.

[0155] <Dielectric Constant>

[0156] The dielectric constant (ε_r) was tested according to China National Standard *GB/T 7265.1-1987* under the condition of 1GHz.

[0157] <Dielectric Loss>

[0158] The dielectric loss (tanδ) was tested according to China National Standard *GB/T 7265.1-1987* under the condition of 1GHz.

[0159] <Ball Drop Test Height>

[0160] A φ20×1 mm sample was placed on a glass carrying fixture, and a 32 g steel ball was dropped from a specified height. The ball drop test height refers to a maximum ball drop test height at which the sample can withstand the impact without breaking. Specifically, the testing is started from a ball drop test height of 100 mm, and the height was changed sequentially, in the case of no breakage, to 100 mm, 200 mm, 300 mm, 400 mm, 500 mm, 600 mm, 700 mm, 800 mm, 900 mm, 1000 mm, 1100 mm, 1200 mm and above. For the examples with "ball drop test height II", the test samples were the microcrystalline glass products. The test data recorded as 1000 mm in the examples indicates that the microcrystalline glass product can withstand the impact without breaking even when the steel ball is dropped from a height of 1000 mm. For the examples with "ball drop test height I", the test samples were the matrix glass. In the present application, the ball drop test height is sometimes referred to as the ball drop height.

[0161] <Knoop Hardness>

[0162] The Knoop hardness was calculated by dividing a load (N) by a surface area (mm^2) of an indentation created by the load. The load was applied on the test surface by a diamond pyramid indenter with an included angle of 172.5° between opposite faces, which created a pyramid-shaped indentation on the test surface, and the surface area was calculated from the length of the indentation. The load was 100 N and applied for 15 seconds. In the present application, the Knoop hardness is also referred to as hardness.

[0163] <Young's Modulus>

[0164] The longitudinal and transverse wave velocities of ultrasound wave traveling through the sample

were measured, and the Young's modulus (E) was calculated using the following formula:

[0165] $$E = \frac{4G^2 - 3GV_T^2\rho}{G - V_T^2\rho}$$

[0166] $$G = V_S^2\rho$$

[0167] in which, E is Young's modulus, Pa;

[0168] G is shear modulus, Pa;

[0169] V_T is transverse wave velocity, m/s;

[0170] V_S is longitudinal wave velocity, m/s;

[0171] ρ is density of glass, g/cm³.

[0172] <Refractive Index>

[0173] The refractive index (n_d) was tested according to the method specified in *GB/T7962.1-2010*.

[0174] The matrix glass of the present application has the following properties:

[0175] 1) In some embodiments, the refractive index (n_d) of the matrix glass of the present application is in a range from 1.51 to 1.55, preferably from 1.52 to 1.54, more preferably from 1.53 to 1.535, and even more preferably from 1.53112 to 1.53284.

[0176] 2) In some embodiments, the Young's modulus (E) of the matrix glass of the present application is in a range from 7000×10^7 Pa to 9500×10^7 Pa, preferably 7500×10^7 Pa to 9200×10^7 Pa, more preferably 7836×10^7 Pa to 9014×10^7 Pa, even more preferably from 8005×10^7 Pa to 8488×10^7 Pa.

[0177] 3) In some embodiments, the Knoop hardness ($Hk_{0.1}$) of the matrix glass of the present application is greater than or equal to 450 kgf/mm², preferably in a range from 470 kgf/mm² to 600 kgf/mm², more preferably from 480 kgf/mm² to 582 kgf/mm², and even more preferably from 492 kgf/mm² to 532 kgf/mm².

[0178] 4) In some embodiments, the ball drop test height I of the matrix glass of the present application is greater than or equal to 200 mm, preferably greater than or equal to 300 mm, and more preferably greater than or equal to 400 mm.

[0179] 5) In some embodiments, the dielectric loss (tanδ) of the matrix glass of the present application is less than or equal to 11.0×10^{-3}, preferably in a range from 7.0×10^{-3} to 10.5×10^{-3}, more preferably from 7.2×10^{-3} to 9.8×10^{-3}, even more preferably from 7.4×10^{-3} to 9.2×10^{-3}.

[0180] 6) In some embodiments, the dielectric constant (ε_r) of the matrix glass of the present application is in a range from 5.5 to 8.5, preferably from 6.0 to 8.0, more preferably from 6.2 to 7.7, and even more preferably from 6.3 to 7.0.

[0181] 7) In some embodiments, the coefficient of linear expansion ($\alpha_{20°C\text{-}300°C}$) of the matrix glass of the present application is less than or equal to 100×10^{-7}/°C, preferably from 65×10^{-7}/°C to 100×10^{-7}/°C, more preferably from 71×10^{-7}/°C to 95×10^{-7}/°C, even more preferably from 75×10^{-7}/°C to 90×10^{-7}/°C.

[0182] The microcrystalline glass of the present application has the following properties:

[0183] 1) In some embodiments, the average transmittance ($T_{400\text{-}800nm}$) of the transparent portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is

greater than or equal to 85.0%, preferably greater than or equal to 88.0%, more preferably greater than or equal to 90.0%, even more preferably greater than or equal to 91.0%, and still more preferably in a range from 91.5% to 95.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0184] 2) In some embodiments, the average transmittance ($T_{400\text{-}800nm}$) of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%, preferably less than or equal to 3.0%, more preferably less than or equal to 1.5%, even more preferably less than or equal to 1.2%, and still more preferably less than or equal to 0.5%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0185] 3) In some embodiments, the transmittance (T_{870nm}) of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is less than or equal to 15.0%, preferably in a range from 0.1% to 12.5%, more preferably 0.1% to 10%, even more preferably 0.1% to 8.0%, and still more preferably 0.1% to 5.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0186] 4) In some embodiments, the transmittance (T_{940nm}) of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is less than or equal to 50.0%, preferably in a range from 0.1% to 35.0%, more preferably from 0.3% to 20.0%, even more preferably from 0.3% to 15.0%, and still more preferably from 0.3% to 10.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0187] In some embodiments, since the transparent portion of the microcrystalline glass of the present application is not undergone crystallization, it has the same properties as the above-mentioned matrix glass, such as Young's modulus (E), Knoop hardness ($Hk_{0.1}$), ball drop test height, dielectric loss (tanδ), dielectric constant (ε_r), coefficient of linear expansion ($\alpha_{20°C\text{-}300°C}$), etc. Specifically, in some embodiments, the Young's modulus (E) of the transparent portion of the microcrystalline glass of the present application is in a range from 7000×10^7 Pa to 9500×10^7 Pa, preferably from 7500×10^7 Pa to 9200×10^7 Pa, more preferably from 7836×10^7 Pa to 9014×10^7 Pa, and even more preferably from 8005×10^7 Pa to 8488×10^7 Pa. In some embodiments, the Knoop hardness ($Hk_{0.1}$) of the transparent portion of the microcrystalline glass of the present application is greater than or equal to 450 kgf/mm^2, preferably in a range from 470 kgf/mm^2 to 600 kgf/mm^2, more preferably from 480 kgf/mm^2 to 582 kgf/mm^2, and even more preferably from 492 kgf/mm^2 to 532 kgf/mm^2. In some embodiments, the ball drop test height of the transparent portion of the microcrystalline glass of the present application is greater than or equal to 200 mm, preferably greater than or equal to 300 mm, and more preferably greater than or equal to 400 mm. In some embodiments, the dielectric loss (tanδ) of the transparent portion of the microcrystalline glass of the present application is less than or equal to 11.0×10^{-3}, preferably in a range from 7.0×10^{-3} to 10.5×10^{-3}, more preferably from 7.2×10^{-3} to 9.8×10^{-3}, even more preferably from 7.4×10^{-3} to 9.2×10^{-3}. In some embodiments, the dielectric constant (ε_r) of the transparent

portion of the microcrystalline glass of the present application is in a range from 5.5 to 8.5, preferably from 6.0 to 8.0, more preferably from 6.2 to 7.7, and even more preferably from 6.3 to 7.0. In some embodiments, the coefficient of linear expansion ($\alpha_{20℃-300℃}$) of the transparent portion of the microcrystalline glass of the present application is less than or equal to 100×10^{-7}/℃, preferably from 65×10^{-7}/℃ to 100×10^{-7}/℃, more preferably from 71×10^{-7}/℃ to 95×10^{-7}/℃, even more preferably from 75×10^{-7}/℃ to 90×10^{-7}/℃.

[0188] The microcrystalline glass product of the present application has the following properties:

[0189] 1) In some embodiments, the average transmittance ($T_{400\text{-}800nm}$) of the transparent portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is greater than or equal to 85.0%, preferably greater than or equal to 88.0%, more preferably greater than or equal to 90.0%, even more preferably greater than or equal to 91.0%, and still more preferably in a range from 91.5% to 95.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0190] 2) In some embodiments, the average transmittance ($T_{400\text{-}800nm}$) of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 5.0%, preferably less than or equal to 3.0%, more preferably less than or equal to 1.5%, even more preferably less than or equal to 1.2%, and still more preferably less than or equal to 0.5%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0191] 3) In some embodiments, the transmittance (T_{870nm}) of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is less than or equal to 15.0%, preferably in a range from 0.1% to 12.5%, more preferably 0.1% to 10%, even more preferably 0.1% to 8.0%, and still more preferably 0.1% to 5.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0192] 4) In some embodiments, the transmittance (T_{940nm}) of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is less than or equal to 50.0%, preferably in a range from 0.1% to 35.0%, more preferably from 0.3% to 20.0%, even more preferably from 0.3% to 15.0%, and still more preferably from 0.3% to 10.0%. The above thickness is preferably in a range from 0.5 mm to 1.5 mm, more preferably from 0.8 mm to 1.2 mm, and even more preferably is 0.5 mm, 0.7 mm, 0.8 mm, 0.9 mm, 1.0 mm, 1.1 mm, or 1.2 mm.

[0193] 5) In some embodiments, the ball drop test height II of the microcrystalline glass product of the present application is greater than or equal to 800 mm, preferably greater than or equal to 900 mm, more preferably greater than or equal to 1000 mm, and even more preferably greater than or equal to 1100 mm.

[0194] In some embodiments, the microcrystalline glass, microcrystalline glass product and matrix glass of the present application have low dielectric constant and low dielectric loss, which can reduce the transmission loss of electrical signals.

[0195] In some embodiments, the microcrystalline glass, microcrystalline glass product and matrix glass

of the present application have a relatively high Knoop hardness, a relatively high Young's modulus and a relatively high ball drop height.

[0196] In some embodiments, the microcrystalline glass, microcrystalline glass product and matrix glass of the present application have a relatively low coefficient of linear expansion, so as to improve the precision of optical signal channels or mask patterns.

[0197] In some embodiments, the microcrystalline glass, microcrystalline glass product and matrix glass of the present application have a relatively low refractive index, which can reduce the reflectance of the surface to optical signals and improve the incidence rate of optical signals.

[0198] Due to the above excellent properties, the microcrystalline glass, microcrystalline glass product and matrix glass of the present application can be widely manufactured into glass cover plates or glass elements. Furthermore, the microcrystalline glass, microcrystalline glass product, and matrix glass of the present application as well as the glass cover plates or glass elements made therefrom can be applied to manufacture of various instruments or devices. The instruments or devices can include, but are not limited to, electronic devices, medical devices, decorations or crafts, such as mobile phones, watches, computers, biomedical detectors, etc., and can be used to manufacture local light-shielding glass or patterned cover glass for mobile phones, smart phones, tablet computers, laptops, televisions, etc., or optical signal channel glass for smart watches, biomedical devices, etc., or patterned decorative or craft glass.

[0199] The matrix glass, microcrystalline glass and microcrystalline glass product of the present application can be produced and manufactured by the following methods:

[0200] The method for manufacturing the matrix glass includes the following steps: weighing raw materials according to the component proportions and mixing uniformly; placing the uniformly mixed raw materials into a platinum or quartz crucible; melting, clarifying, and homogenizing at 1450 °C to 1600 °C, and then cooling; pouring the molten glass liquid into a mold for molding, and introducing circulating cooling air to ensure that the glass does not crystallize, preferably, preheating the mold to 200 °C to 500 °C, placing the molded glass together with the mold into an annealing furnace and conducting heat preservation and annealing, then turning off the power and cooling with the furnace to obtain the matrix glass.

[0201] The method for manufacturing the microcrystalline glass includes the following steps: forming a matrix glass; and either performing a crystallization process on the matrix glass or processing the matrix glass into a glass element of a specific shape and then performing a crystallization process on the glass element, to obtain the microcrystalline glass of the present application. In the present application, the method for processing the matrix glass into the glass element of the specific shape includes hot pressing, grinding, polishing, or other processes known to those skilled in the art. In the present application, the crystallization process includes subjecting the matrix glass to a mask exposure treatment and subsequently to a crystallization heat treatment, so as to uniformly precipitate crystals in the exposed position of the glass. In the present application, the mask exposure treatment refers to exposing a specific position or region of the matrix glass to ultraviolet light, preferably with a wavelength of 313 nm. A special photomask pattern can be customized according to application needs, and an exposure duration preferably ranges from 5 minutes to 60 minutes. The crystallization heat treatment in the present application can be carried out in one stage or in two stages,

preferably in two stages. The two-stage crystallization heat treatment refers to performing a nucleation process at a first temperature and then performing a crystal growth process at a second temperature higher than the nucleation process temperature. Preferably, the first temperature is in a range from 490 °C to 520 °C. The treatment duration at the first temperature is preferably in a range from 1 hour to 4 hours. The second temperature is preferably in a range from 540 °C to 620 °C. The treatment duration at the second temperature is preferably in a range from 1 hour to 8 hours.

[0202] The method for manufacturing the microcrystalline glass product includes the following steps: either subjecting the microcrystalline glass of the present application to a chemical strengthening process, or processing the microcrystalline glass into a microcrystalline glass element of a specific shape and then performing a chemical strengthening process, to obtain the microcrystalline glass product of the present application. The method for processing the microcrystalline glass into a specific shape in the present application includes hot pressing, grinding, polishing, or other processes known to those skilled in the art.

[0203] The chemical strengthening in the present application refers to an ion exchange process. In the ion exchange process, smaller metal ions in the microcrystalline glass are replaced or "exchanged" with larger metal ions with the same valence which are adjacent to the microcrystalline glass. Replacing smaller ions with larger ions builds compressive stress in the microcrystalline glass, forming a compressive stress layer.

[0204] In some embodiments, the metal ions are monovalent alkali metal ions (e.g., Na^+, K^+, Rb^+, Cs^+, etc.), and the ion exchange is performed by immersing the microcrystalline glass in a salt bath containing at least one molten salt including the larger metal ions, which are used to replace the smaller metal ions in the microcrystalline glass. Alternatively, other monovalent metal ions such as Ag^+, Tl^+, Cu^+, etc. can also be used to exchange monovalent ions. One or more ion exchange processes used to chemically strengthen the microcrystalline glass can include, but are not limited to, immersing the microcrystalline glass in a single salt bath, or sequentially immersing the microcrystalline glass in multiple salt baths with the same or different compositions, with optional washing and/or annealing steps between immersions.

[0205] In some embodiments, the ion exchange is conducted by immersing the microcrystalline glass in a salt bath of a molten Na salt (e.g., $NaNO_3$), and/or a molten K salt (e.g., KNO_3), and/or a molten Na and K mixed salt at a temperature of about 350 °C to 470 °C for 1 to 36 hours. The temperature is preferably in a range from 380 °C to 460 °C. The time period is preferably in a range from 2 hours to 24 hours.

[0206] In some embodiments, the matrix glass of the present application can be subjected to the above chemical strengthening process to obtain a strengthened glass, and then subjected to the above crystallization process to obtain the microcrystalline glass product. In some embodiments, the matrix glass of the present application can be processed into a glass element, then the glass element can be subjected to the above chemical strengthening process to obtain a strengthened glass, and then subjected to the above crystallization process to obtain the microcrystalline glass product.

[0207] Examples

[0208] To further illustrate and explain the technical solutions of the present application clearly, the following non-limiting examples are provided. The examples of the present application have been prepared with many efforts to ensure the accuracy of numerical values (such as amounts, etc.), but some errors and

deviations should be taken into account. The components themselves are given in weight percentage based on oxides and have been normalized to 100%.

[0209] <Matrix Glass Examples>

[0210] In these examples, matrix glasses having the components shown in Tables 1 to 4 were obtained using the above-described method for manufacturing the matrix glass. In addition, the properties of each matrix glass were measured by the test methods described in the present application, and the measurement results are shown in Tables 1 to 4.

[0211] Table 1

Example (wt%)	1#	2#	3#	4#	5#	6#	7#	8#	9#	10#
SiO_2	72.66	67.2	69.9	65	77.19	74.37	75.58	70.1	69.2	71.5
Al_2O_3	7.4	9.46	6.9	10	3	6.7	5.5	5.9	7.7	9
Li_2O	10	8.7	11.6	10.5	9.9	10.6	8.6	11.5	8.7	8.3
K_2O	4.2	3.8	3.5	5.5	2.5	2.7	4.8	4.1	5.1	2.2
Na_2O	2.2	5.6	4.9	3.6	3	2.6	1.7	3.9	4.3	5
ZrO_2	2.6	4.5	2.2	4.6	3.5	2.5	3.1	3.2	4	1.5
CeO_2	0.1	0.07	0.12	0.06	0.14	0.07	0.08	0.14	0.1	0.09
Ag_2O	0.2	0.42	0.38	0.32	0.34	0.27	0.33	0.45	0.47	0.41
Sb_2O_3	0.52	0.2	0.36	0.32	0.42	0.15	0.15	0.09	0.32	0.46
SnO_2	0.12	0.05	0.14	0.1	0.01	0.04	0.16	0.12	0.11	0.04
ZnO	0	0	0	0	0	0	0	0	0	1.5
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0.5	0	0

Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.4	9.4	8.4	9.1	5.5	5.3	6.5	8	9.4	7.2
SiO_2/Li_2O	7.27	7.72	6.03	6.19	7.8	7.02	8.79	6.1	7.95	8.61
$Sb_2O_3+SnO_2$	0.64	0.25	0.5	0.42	0.43	0.19	0.31	0.21	0.43	0.5
$(Sb_2O_3+SnO_2)/Ag_2O$	3.2	0.6	1.32	1.31	1.26	0.7	0.94	0.47	0.91	1.22
Ag_2O/CeO_2	2	6	3.17	5.33	2.43	3.86	4.13	3.21	4.7	4.56
Li_2O/ZrO_2	3.85	1.93	5.27	2.28	2.83	4.24	2.77	3.59	2.18	5.53
$(K_2O+Na_2O)/ZrO_2$	2.46	2.09	3.82	1.98	1.57	2.12	2.1	2.5	2.35	4.8
$(SiO_2+Li_2O)/ZrO_2$	31.79	16.87	37.05	16.41	24.88	33.99	27.15	25.50	19.48	53.2
MO/ZrO_2	0	0	0	0	0	0	0	0	0	1
$ZrO_2/(Ag_2O+CeO_2)$	8.67	9.18	4.4	12.11	7.29	7.35	7.56	5.42	7.02	3
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	8.4	9.57	7.33	12.33	5.5	6.57	8	4.71	9	10.11
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	3.7	0.76	1.63	1.50	1.68	0.96	1.18	0.78	1.13	1.44
$SnO_2/(CeO_2+SnO_2)$	0.55	0.42	0.54	0.63	0.07	0.36	0.67	0.46	0.52	0.31
$R_2O+Li_2O+Al_2O_3$	23.8	27.56	26.9	29.6	18.4	22.6	20.6	25.4	25.8	24.5
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	4.88	4.24	3.84	3.83	5.21	5.1	5.37	3.9	4.25	5.19
ε_r	6.9	7.3	7.2	7.5	6.3	6.8	6.6	7.1	7.1	7.2
$Tan\delta(\times10^{-3})$	8.7	9.57	9.43	10.06	7.43	8.43	7.96	9.13	9.17	9.33
$HK_{0.1}(kgf/mm^2)$	516	494	479	478	528	523	532	479	493	506
$E(\times10^7Pa)$	8254	8035	7892	7886	8372	8324	8413	7897	8032	8157
$\alpha_{20°C-300°C}(\times10^{-7}/°C)$	83	90	95	95	79	81	78	95	90	86
Drop ball test height I (mm)	400	400	300	300	400	400	400	400	300	400
n_d	1.53234	1.53277	1.53238	1.53284	1.53037	1.53225	1.53190	1.53216	1.53252	1.53265

[0212] Table 2

Example (wt%)	11#	12#	13#	14#	15#	16#	17#	18#	19#	20#

SiO_2	73.78	72.36	76.2	74.27	69.2	72.56	70.4	72.7	76.3	75.4
Al_2O_3	6.9	5.3	3.8	4.9	5.5	4.9	7	7.8	5.4	6.4
Li_2O	7.5	8.3	9.2	9.6	10.4	7.3	11.9	10	10.5	8
K_2O	1.1	3.4	2.4	3	3.8	3.3	4	3.3	1.4	2.3
Na_2O	3.4	3.7	2	2.5	4.4	4.1	1.5	1.3	1.5	2.2
ZrO_2	6.6	6.1	5.6	4.5	6.2	5.3	4.7	4.1	3.9	5.2
CeO_2	0.07	0.13	0.13	0.1	0.09	0.1	0.12	0.11	0.13	0.11
Ag_2O	0.42	0.44	0.3	0.46	0.24	0.37	0.23	0.22	0.32	0.23
Sb_2O_3	0.07	0.1	0.22	0.55	0.07	0.06	0.08	0.45	0.51	0.11
SnO_2	0.16	0.17	0.15	0.12	0.1	0.01	0.07	0.02	0.04	0.05
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	2	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	4.5	7.1	4.4	5.5	8.2	7.4	5.5	4.6	2.9	4.5
SiO_2/Li_2O	9.84	8.72	8.28	7.74	6.65	9.94	5.92	7.27	7.27	9.43
$Sb_2O_3+SnO_2$	0.23	0.27	0.37	0.67	0.17	0.07	0.15	0.47	0.55	0.16
$(Sb_2O_3+SnO_2)/Ag_2O$	0.55	0.61	1.23	1.46	0.71	0.19	0.65	2.14	1.72	0.7
Ag_2O/CeO_2	6	3.38	2.31	4.6	2.67	3.7	1.92	2	2.46	2.09

Li_2O/ZrO_2	1.14	1.36	1.64	2.13	1.68	1.38	2.53	2.44	2.69	1.54
$(K_2O+Na_2O)/ZrO_2$	0.68	1.16	0.79	1.22	1.32	1.4	1.17	1.12	0.74	0.87
$(SiO_2+Li_2O)/ZrO_2$	12.32	13.22	15.25	18.64	12.84	15.07	17.51	20.17	22.26	16.04
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	13.47	10.7	13.02	8.04	18.79	11.28	13.43	12.42	8.67	15.29
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	9.29	5.46	5.15	11.3	4.56	4.4	3.17	6.27	6.69	3.55
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	0.71	0.91	1.67	1.67	1.08	0.46	1.17	2.64	2.13	1.17
$SnO_2/(CeO_2+SnO_2)$	0.7	0.57	0.54	0.55	0.53	0.09	0.37	0.15	0.24	0.31
$R_2O+Li_2O+Al_2O_3$	18.9	20.7	17.4	20	24.1	19.6	24.4	22.4	18.8	18.9
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	6.72	5.04	5.88	5.24	4.02	5.27	4.45	5.51	6.1	6.54
ε_r	6.4	6.5	6.2	6.5	6.9	6.7	7.0	6.7	6.4	6.4
$Tan\delta(\times10^{-3})$	7.56	7.94	7.2	7.78	8.78	8.19	8.86	8.36	7.53	7.55
$HK_{0.1}(kgf/mm^2)$	582	523	553	531	485	507	500	540	559	577
$E(\times10^7Pa)$	8892	8322	8611	8396	7951	8166	8094	8488	8677	8846
$\alpha_{20°C-300°C}(\times10^{-7}/°C)$	66	81	71	78	93	86	88	75	69	63
Drop ball test height I (mm)	400	400	400	400	300	400	400	400	400	400
n_d	1.53230	1.53191	1.53112	1.53173	1.53207	1.53176	1.53239	1.53248	1.53186	1.53216

[0213] Table 3

Example (wt%)	21#	22#	23#	24#	25#	26#	27#	28#	29#	30#
SiO_2	72.76	72	72.5	69.8	69.4	73.5	71	71.5	67.5	78
Al_2O_3	5.7	6	6.1	6.5	8.4	7.6	7.9	9.5	6	3
Li_2O	9.2	10.2	9.8	10	12	9.2	11.2	9.8	11.6	11.8
K_2O	4.3	3	3.1	5.2	2.1	2.5	3.7	1.8	3.7	3
Na_2O	1.9	2.5	2.8	5.4	3.3	1.7	4	3.7	4.1	1
ZrO_2	5.5	5.5	4.8	2.4	3.7	4.6	1.6	2.9	6.5	2.1

CeO_2	0.1	0.1	0.15	0.14	0.09	0.1	0.07	0.11	0.12	0.14
Ag_2O	0.29	0.33	0.22	0.21	0.5	0.31	0.3	0.4	0.32	0.4
Sb_2O_3	0.07	0.23	0.42	0.3	0.43	0.29	0.22	0.21	0.14	0.46
SnO_2	0.18	0.14	0.11	0.05	0.08	0.2	0.01	0.08	0.02	0.1
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.2	5.5	5.9	10.6	5.4	4.2	7.7	5.5	7.8	4
SiO_2/Li_2O	7.91	7.06	7.40	6.98	5.78	7.99	6.34	7.30	5.82	6.61
$Sb_2O_3+SnO_2$	0.25	0.37	0.53	0.35	0.51	0.49	0.23	0.29	0.16	0.56
$(Sb_2O_3+SnO_2)/Ag_2O$	0.86	1.12	2.41	1.67	1.02	1.58	0.77	0.73	0.5	1.4
Ag_2O/CeO_2	2.9	3.3	1.47	1.5	5.56	3.1	4.29	3.64	2.67	2.86
Li_2O/ZrO_2	1.67	1.85	2.04	4.17	3.24	2	7	3.38	1.78	5.62
$(K_2O+Na_2O)/ZrO_2$	1.13	1	1.23	4.42	1.46	0.91	4.81	1.9	1.2	1.9
$(SiO_2+Li_2O)/ZrO_2$	14.9	14.95	17.15	33.25	22	17.98	51.38	28.03	12.17	42.76
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	14.1	12.79	12.97	6.86	6.27	11.22	4.32	5.69	14.77	3.89
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	5.4	7	5	4	11.22	8	7.57	6.27	4	6.86

$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	1.21	1.42	3.09	2.33	1.2	1.9	1	1	0.88	1.75
$SnO_2/(CeO_2+SnO_2)$	0.64	0.58	0.42	0.26	0.47	0.67	0.13	0.42	0.14	0.42
$R_2O+Li_2O+Al_2O_3$	21.1	21.7	21.8	27.1	25.8	21	26.8	24.8	25.4	18.8
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.09	4.97	5.01	3.7	4.47	6.05	4.17	5.29	3.79	5.13
ε_r	6.6	6.7	6.7	7.3	7.1	6.6	7.2	7.0	7.1	6.4
$Tan\delta(\times10^{-3})$	8.07	8.24	8.26	9.5	9.17	8.06	9.41	8.94	9.08	7.54
$HK_{0.1}(kgf/mm^2)$	523	519	520	473	501	558	490	531	477	524
$E(\times10^7Pa)$	8326	8284	8289	7836	8109	8660	8005	8396	7871	8334
$\alpha_{20°C-300°C}(\times10^{-7}/°C)$	81	82	82	97	88	69	91	78	96	80
Drop ball test height I (mm)	400	400	400	300	300	400	400	400	300	400
n_d	1.53203	1.53216	1.53216	1.53231	1.53261	1.53244	1.53252	1.53271	1.53223	1.53034

[0214] Table 4

Example (wt%)	31#	32#	33#	34#	35#	36#	37#	38#	39#	40#
SiO_2	71.1	70.9	73.5	72.3	74.2	72.5	72.1	72.9	70.1	70.5
Al_2O_3	8.9	8.4	3.5	7.6	5.9	6	6	4.8	9.7	8
Li_2O	8.5	10.2	11	9.6	9.8	10.4	10.7	10.8	7.4	11.6
K_2O	1.8	3.2	3.8	2.3	3.2	3.4	4.5	3.7	4.6	1.1
Na_2O	5.5	1.9	3.2	1.1	2.9	2.1	2.8	3.9	1.3	2.5
ZrO_2	2	4.8	4.3	2	3.4	5.1	3	3.4	6.1	5.4
CeO_2	0.15	0.12	0.09	0.15	0.09	0.1	0.11	0.1	0.13	0.13
Ag_2O	0.36	0.24	0.23	0.34	0.29	0.22	0.3	0.25	0.24	0.3
Sb_2O_3	0.5	0.21	0.31	0.43	0.15	0.08	0.39	0.14	0.35	0.44
SnO_2	0.09	0.03	0.07	0.18	0.07	0.1	0.1	0.01	0.08	0.03
ZnO	1.1	0	0	4	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0

CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	7.3	5.1	7	3.4	6.1	5.5	7.3	7.6	5.9	3.6
SiO_2/Li_2O	8.36	6.95	6.68	7.53	7.57	6.97	6.74	6.75	9.47	6.08
$Sb_2O_3+SnO_2$	0.59	0.24	0.38	0.61	0.22	0.18	0.49	0.15	0.43	0.47
$(Sb_2O_3+SnO_2)/Ag_2O$	1.64	1	1.65	1.79	0.76	0.82	1.63	0.60	1.79	1.57
Ag_2O/CeO_2	2.4	2	2.56	2.27	3.22	2.2	2.73	2.5	1.85	2.31
Li_2O/ZrO_2	4.25	2.13	2.56	4.8	2.88	2.04	3.57	3.18	1.21	2.15
$(K_2O+Na_2O)/ZrO_2$	3.65	1.06	1.63	1.7	1.79	1.08	2.43	2.24	0.97	0.67
$(SiO_2+Li_2O)/ZrO_2$	39.8	16.9	19.65	40.95	24.71	16.25	27.6	24.62	12.7	15.2
MO/ZrO_2	0.55	0	0	2	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	3.92	13.33	13.44	4.08	8.95	15.94	7.32	9.71	16.49	12.56
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	6.33	4	6.78	6.33	5.67	4	7.18	4	5.15	5.92
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	2.06	1.5	2.04	2.24	1.07	1.27	2	1	2.33	2
$SnO_2/(CeO_2+SnO_2)$	0.38	0.2	0.44	0.55	0.44	0.5	0.48	0.09	0.38	0.19
$R_2O+Li_2O+Al_2O_3$	24.7	23.7	21.5	20.6	21.8	21.9	24	23.2	23	23.2
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.06	5.18	4.28	6.15	5.04	4.94	4.34	4.22	6	5.16
ε_r	7.2	6.9	6.7	6.7	6.7	6.7	6.9	6.8	6.8	6.8
$Tan\delta(\times10^{-3})$	9.39	8.7	8.18	8.19	8.25	8.28	8.76	8.56	8.53	8.56

$HK_{0.1}(kgf/mm^2)$	502	526	494	555	521	517	496	492	554	526
$E(\times 10^7 Pa)$	8118	8348	8038	8629	8299	8264	8060	8021	8624	8351
$\alpha_{20°C-300°C}(\times 10^{-7}/°C)$	88	80	90	70	81	83	90	91	71	80
Drop ball test height I (mm)	400	400	400	400	400	400	400	400	400	400
n_d	1.53265	1.53259	1.53098	1.53238	1.53207	1.53212	1.53213	1.53172	1.53274	1.53254

[0215] <Microcrystalline glass Examples>

[0216] In these examples, microcrystalline glass having the components shown in Tables 5 to 8 were obtained using the above-described method for manufacturing the microcrystalline glass. In addition, the properties of each microcrystalline glass were measured by the test methods described in the present application, and the measurement results are shown in Tables 5 to 8. In the following examples, the sample of microcrystalline glass used for measuring the transmittance had a thickness of 1 mm.

[0217] Table 5

Example (wt%)	1#	2#	3#	4#	5#	6#	7#	8#	9#	10#
SiO_2	72.66	67.2	69.9	65	77.19	74.37	75.58	70.1	69.2	71.5
Al_2O_3	7.4	9.46	6.9	10	3	6.7	5.5	5.9	7.7	9
Li_2O	10	8.7	11.6	10.5	9.9	10.6	8.6	11.5	8.7	8.3
K_2O	4.2	3.8	3.5	5.5	2.5	2.7	4.8	4.1	5.1	2.2
Na_2O	2.2	5.6	4.9	3.6	3	2.6	1.7	3.9	4.3	5
ZrO_2	2.6	4.5	2.2	4.6	3.5	2.5	3.1	3.2	4	1.5
CeO_2	0.1	0.07	0.12	0.06	0.14	0.07	0.08	0.14	0.1	0.09
Ag_2O	0.2	0.42	0.38	0.32	0.34	0.27	0.33	0.45	0.47	0.41
Sb_2O_3	0.52	0.2	0.36	0.32	0.42	0.15	0.15	0.09	0.32	0.46
SnO_2	0.12	0.05	0.14	0.1	0.01	0.04	0.16	0.12	0.11	0.04
ZnO	0	0	0	0	0	0	0	0	0	1.5
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0

BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0.5	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.4	9.4	8.4	9.1	5.5	5.3	6.5	8	9.4	7.2
SiO_2/Li_2O	7.27	7.72	6.03	6.19	7.8	7.02	8.79	6.1	7.95	8.61
$Sb_2O_3+SnO_2$	0.64	0.25	0.5	0.42	0.43	0.19	0.31	0.21	0.43	0.5
$(Sb_2O_3+SnO_2)/Ag_2O$	3.2	0.6	1.32	1.31	1.26	0.7	0.94	0.47	0.91	1.22
Ag_2O/CeO_2	2	6	3.17	5.33	2.43	3.86	4.13	3.21	4.7	4.56
Li_2O/ZrO_2	3.85	1.93	5.27	2.28	2.83	4.24	2.77	3.59	2.18	5.53
$(K_2O+Na_2O)/ZrO_2$	2.46	2.09	3.82	1.98	1.57	2.12	2.1	2.5	2.35	4.8
$(SiO_2+Li_2O)/ZrO_2$	31.79	16.87	37.05	16.41	24.88	33.99	27.15	25.50	19.48	53.2
MO/ZrO_2	0	0	0	0	0	0	0	0	0	1
$ZrO_2/(Ag_2O+CeO_2)$	8.67	9.18	4.4	12.11	7.29	7.35	7.56	5.42	7.02	3
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	8.4	9.57	7.33	12.33	5.5	6.57	8	4.71	9	10.11
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	3.7	0.76	1.63	1.50	1.68	0.96	1.18	0.78	1.13	1.44
$SnO_2/(CeO_2+SnO_2)$	0.55	0.42	0.54	0.63	0.07	0.36	0.67	0.46	0.52	0.31
$R_2O+Li_2O+Al_2O_3$	23.8	27.56	26.9	29.6	18.4	22.6	20.6	25.4	25.8	24.5
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	4.88	4.24	3.84	3.83	5.21	5.1	5.37	3.9	4.25	5.19
Transparent portion $T_{400\text{-}800nm}$ (%)	91.8	92.0	91.6	91.8	92.0	92.0	90.7	91.6	91.8	92.0
Blackened portion T_{940nm} (%)	0.3	21.7	3.3	2.8	4.0	17.1	10.1	2.5	11.1	4.8
Blackened portion T_{870nm} (%)	0.3	7.6	1.2	1.0	1.4	6.0	3.5	0.9	3.9	1.7
Blackened portion $T_{400\text{-}800nm}$ (%)	0	0.7	0.3	0.3	0.3	0.6	0.5	0.3	0.5	0.3

[0218] Table 6

Example (wt%)	11#	12#	13#	14#	15#	16#	17#	18#	19#	20#
SiO_2	73.78	72.36	76.2	74.27	69.2	72.56	70.4	72.7	76.3	75.4
Al_2O_3	6.9	5.3	3.8	4.9	5.5	4.9	7	7.8	5.4	6.4
Li_2O	7.5	8.3	9.2	9.6	10.4	7.3	11.9	10	10.5	8
K_2O	1.1	3.4	2.4	3	3.8	3.3	4	3.3	1.4	2.3
Na_2O	3.4	3.7	2	2.5	4.4	4.1	1.5	1.3	1.5	2.2
ZrO_2	6.6	6.1	5.6	4.5	6.2	5.3	4.7	4.1	3.9	5.2
CeO_2	0.07	0.13	0.13	0.1	0.09	0.1	0.12	0.11	0.13	0.11
Ag_2O	0.42	0.44	0.3	0.46	0.24	0.37	0.23	0.22	0.32	0.23
Sb_2O_3	0.07	0.1	0.22	0.55	0.07	0.06	0.08	0.45	0.51	0.11
SnO_2	0.16	0.17	0.15	0.12	0.1	0.01	0.07	0.02	0.04	0.05
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	2	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	4.5	7.1	4.4	5.5	8.2	7.4	5.5	4.6	2.9	4.5
SiO_2/Li_2O	9.84	8.72	8.28	7.74	6.65	9.94	5.92	7.27	7.27	9.43
$Sb_2O_3+SnO_2$	0.23	0.27	0.37	0.67	0.17	0.07	0.15	0.47	0.55	0.16

$(Sb_2O_3+SnO_2)/Ag_2O$	0.55	0.61	1.23	1.46	0.71	0.19	0.65	2.14	1.72	0.7
Ag_2O/CeO_2	6	3.38	2.31	4.6	2.67	3.7	1.92	2	2.46	2.09
Li_2O/ZrO_2	1.14	1.36	1.64	2.13	1.68	1.38	2.53	2.44	2.69	1.54
$(K_2O+Na_2O)/ZrO_2$	0.68	1.16	0.79	1.22	1.32	1.4	1.17	1.12	0.74	0.87
$(SiO_2+Li_2O)/ZrO_2$	12.32	13.22	15.25	18.64	12.84	15.07	17.51	20.17	22.26	16.04
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	13.47	10.7	13.02	8.04	18.79	11.28	13.43	12.42	8.67	15.29
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	9.29	5.46	5.15	11.3	4.56	4.4	3.17	6.27	6.69	3.55
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	0.71	0.91	1.67	1.67	1.08	0.46	1.17	2.64	2.13	1.17
$SnO_2/(CeO_2+SnO_2)$	0.7	0.57	0.54	0.55	0.53	0.09	0.37	0.15	0.24	0.31
$R_2O+Li_2O+Al_2O_3$	18.9	20.7	17.4	20	24.1	19.6	24.4	22.4	18.8	18.9
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	6.72	5.04	5.88	5.24	4.02	5.27	4.45	5.51	6.1	6.54
Transparent portion $T_{400\text{-}800nm}$ (%)	90.7	90.7	91.5	90.7	91.8	92.0	92.0	92.0	92.0	92.0
Blackened portion T_{940nm} (%)	20.7	18.8	4.7	1.0	19.7	35.9	18.3	0.4	0.4	12.8
Blackened portion T_{870nm} (%)	7.3	6.6	1.7	0.4	6.9	12.6	6.4	0.1	0.1	4.5
Blackened portion $T_{400\text{-}800nm}$ (%)	0.7	0.6	0.3	0.2	0.6	1.2	0.6	0	0	0.2

[0219] Table 7

Example (wt%)	21#	22#	23#	24#	25#	26#	27#	28#	29#	30#
SiO_2	72.76	72	72.5	69.8	69.4	73.5	71	71.5	67.5	78
Al_2O_3	5.7	6	6.1	6.5	8.4	7.6	7.9	9.5	6	3
Li_2O	9.2	10.2	9.8	10	12	9.2	11.2	9.8	11.6	11.8
K_2O	4.3	3	3.1	5.2	2.1	2.5	3.7	1.8	3.7	3
Na_2O	1.9	2.5	2.8	5.4	3.3	1.7	4	3.7	4.1	1
ZrO_2	5.5	5.5	4.8	2.4	3.7	4.6	1.6	2.9	6.5	2.1
CeO_2	0.1	0.1	0.15	0.14	0.09	0.1	0.07	0.11	0.12	0.14

Ag_2O	0.29	0.33	0.22	0.21	0.5	0.31	0.3	0.4	0.32	0.4
Sb_2O_3	0.07	0.23	0.42	0.3	0.43	0.29	0.22	0.21	0.14	0.46
SnO_2	0.18	0.14	0.11	0.05	0.08	0.2	0.01	0.08	0.02	0.1
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.2	5.5	5.9	10.6	5.4	4.2	7.7	5.5	7.8	4
SiO_2/Li_2O	7.91	7.06	7.40	6.98	5.78	7.99	6.34	7.30	5.82	6.61
$Sb_2O_3+SnO_2$	0.25	0.37	0.53	0.35	0.51	0.49	0.23	0.29	0.16	0.56
$(Sb_2O_3+SnO_2)/Ag_2O$	0.86	1.12	2.41	1.67	1.02	1.58	0.77	0.73	0.5	1.4
Ag_2O/CeO_2	2.9	3.3	1.47	1.5	5.56	3.1	4.29	3.64	2.67	2.86
Li_2O/ZrO_2	1.67	1.85	2.04	4.17	3.24	2	7	3.38	1.78	5.62
$(K_2O+Na_2O)/ZrO_2$	1.13	1	1.23	4.42	1.46	0.91	4.81	1.9	1.2	1.9
$(SiO_2+Li_2O)/ZrO_2$	14.9	14.95	17.15	33.25	22	17.98	51.38	28.03	12.17	42.76
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	14.1	12.79	12.97	6.86	6.27	11.22	4.32	5.69	14.77	3.89
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	5.4	7	5	4	11.22	8	7.57	6.27	4	6.86
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	1.21	1.42	3.09	2.33	1.2	1.9	1	1	0.88	1.75

$SnO_2/(CeO_2+SnO_2)$	0.64	0.58	0.42	0.26	0.47	0.67	0.13	0.42	0.14	0.42
$R_2O+Li_2O+Al_2O_3$	21.1	21.7	21.8	27.1	25.8	21	26.8	24.8	25.4	18.8
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.09	4.97	5.01	3.7	4.47	6.05	4.17	5.29	3.79	5.13
Transparent portion $T_{400\text{-}800nm}$ (%)	90.8	91.6	91.6	92.0	92.0	90.5	92.0	92.0	92.0	90.5
Blackened portion T_{940nm} (%)	12.6	7.0	7.9	2.1	6.4	0.9	17.0	17.5	24.6	0.5
Blackened portion T_{870nm} (%)	4.4	2.5	2.8	0.7	2.2	0.3	6.0	6.2	8.6	0.2
Blackened portion $T_{400\text{-}800nm}$ (%)	0.2	0.4	0.4	0.3	0.4	0.1	0.6	0.6	0.7	0

[0220] Table 8

Example (wt%)	31#	32#	33#	34#	35#	36#	37#	38#	39#	40#
SiO_2	71.1	70.9	73.5	72.3	74.2	72.5	72.1	72.9	70.1	70.5
Al_2O_3	8.9	8.4	3.5	7.6	5.9	6	6	4.8	9.7	8
Li_2O	8.5	10.2	11	9.6	9.8	10.4	10.7	10.8	7.4	11.6
K_2O	1.8	3.2	3.8	2.3	3.2	3.4	4.5	3.7	4.6	1.1
Na_2O	5.5	1.9	3.2	1.1	2.9	2.1	2.8	3.9	1.3	2.5
ZrO_2	2	4.8	4.3	2	3.4	5.1	3	3.4	6.1	5.4
CeO_2	0.15	0.12	0.09	0.15	0.09	0.1	0.11	0.1	0.13	0.13
Ag_2O	0.36	0.24	0.23	0.34	0.29	0.22	0.3	0.25	0.24	0.3
Sb_2O_3	0.5	0.21	0.31	0.43	0.15	0.08	0.39	0.14	0.35	0.44
SnO_2	0.09	0.03	0.07	0.18	0.07	0.1	0.1	0.01	0.08	0.03
ZnO	1.1	0	0	4	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0

Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	7.3	5.1	7	3.4	6.1	5.5	7.3	7.6	5.9	3.6
SiO_2/Li_2O	8.36	6.95	6.68	7.53	7.57	6.97	6.74	6.75	9.47	6.08
$Sb_2O_3+SnO_2$	0.59	0.24	0.38	0.61	0.22	0.18	0.49	0.15	0.43	0.47
$(Sb_2O_3+SnO_2)/Ag_2O$	1.64	1	1.65	1.79	0.76	0.82	1.63	0.60	1.79	1.57
Ag_2O/CeO_2	2.4	2	2.56	2.27	3.22	2.2	2.73	2.5	1.85	2.31
Li_2O/ZrO_2	4.25	2.13	2.56	4.8	2.88	2.04	3.57	3.18	1.21	2.15
$(K_2O+Na_2O)/ZrO_2$	3.65	1.06	1.63	1.7	1.79	1.08	2.43	2.24	0.97	0.67
$(SiO_2+Li_2O)/ZrO_2$	39.8	16.9	19.65	40.95	24.71	16.25	27.6	24.62	12.7	15.2
MO/ZrO_2	0.55	0	0	2	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	3.92	13.33	13.44	4.08	8.95	15.94	7.32	9.71	16.49	12.56
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	6.33	4	6.78	6.33	5.67	4	7.18	4	5.15	5.92
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	2.06	1.5	2.04	2.24	1.07	1.27	2	1	2.33	2
$SnO_2/(CeO_2+SnO_2)$	0.38	0.2	0.44	0.55	0.44	0.5	0.48	0.09	0.38	0.19
$R_2O+Li_2O+Al_2O_3$	24.7	23.7	21.5	20.6	21.8	21.9	24	23.2	23	23.2
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.06	5.18	4.28	6.15	5.04	4.94	4.34	4.22	6	5.16
Transparent portion $T_{400\text{-}800nm}$ (%)	91.8	92.0	92.0	90.8	92.0	92.0	92.0	92.0	92.0	92.0
Blackened portion T_{940nm} (%)	0.3	7.1	0.5	0.9	22.7	9.7	0.7	21.7	0.3	1.0
Blackened portion T_{870nm} (%)	0.1	2.5	0.2	0.3	8.0	3.4	0.2	7.6	0.1	0.3
Blackened portion $T_{400\text{-}800nm}$ (%)	0	0.4	0	0	0.7	0.2	0	0.7	0	0.1

[0221] <Crystalline glass product Examples>

[0222] In these examples, microcrystalline glass products having the components shown in Tables 9 to 12 were obtained using the above-described method for manufacturing the microcrystalline glass product. In addition, the properties of each microcrystalline glass product were measured by the test methods described in

the present application, and the measurement results are shown in Tables 9 to 12. In the following examples, the sample of microcrystalline glass product used for measuring the transmittance had a thickness of 1 mm.

[0223] Table 9

Example (wt%)	1#	2#	3#	4#	5#	6#	7#	8#	9#	10#
SiO_2	72.66	67.2	69.9	65	77.19	74.37	75.58	70.1	69.2	71.5
Al_2O_3	7.4	9.46	6.9	10	3	6.7	5.5	5.9	7.7	9
Li_2O	10	8.7	11.6	10.5	9.9	10.6	8.6	11.5	8.7	8.3
K_2O	4.2	3.8	3.5	5.5	2.5	2.7	4.8	4.1	5.1	2.2
Na_2O	2.2	5.6	4.9	3.6	3	2.6	1.7	3.9	4.3	5
ZrO_2	2.6	4.5	2.2	4.6	3.5	2.5	3.1	3.2	4	1.5
CeO_2	0.1	0.07	0.12	0.06	0.14	0.07	0.08	0.14	0.1	0.09
Ag_2O	0.2	0.42	0.38	0.32	0.34	0.27	0.33	0.45	0.47	0.41
Sb_2O_3	0.52	0.2	0.36	0.32	0.42	0.15	0.15	0.09	0.32	0.46
SnO_2	0.12	0.05	0.14	0.1	0.01	0.04	0.16	0.12	0.11	0.04
ZnO	0	0	0	0	0	0	0	0	0	1.5
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0.5	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.4	9.4	8.4	9.1	5.5	5.3	6.5	8	9.4	7.2
SiO_2/Li_2O	7.27	7.72	6.03	6.19	7.8	7.02	8.79	6.1	7.95	8.61

$Sb_2O_3+SnO_2$	0.64	0.25	0.5	0.42	0.43	0.19	0.31	0.21	0.43	0.5
$(Sb_2O_3+SnO_2)/Ag_2O$	3.2	0.6	1.32	1.31	1.26	0.7	0.94	0.47	0.91	1.22
Ag_2O/CeO_2	2	6	3.17	5.33	2.43	3.86	4.13	3.21	4.7	4.56
Li_2O/ZrO_2	3.85	1.93	5.27	2.28	2.83	4.24	2.77	3.59	2.18	5.53
$(K_2O+Na_2O)/ZrO_2$	2.46	2.09	3.82	1.98	1.57	2.12	2.1	2.5	2.35	4.8
$(SiO_2+Li_2O)/ZrO_2$	31.79	16.87	37.05	16.41	24.88	33.99	27.15	25.50	19.48	53.2
MO/ZrO_2	0	0	0	0	0	0	0	0	0	1
$ZrO_2/(Ag_2O+CeO_2)$	8.67	9.18	4.4	12.11	7.29	7.35	7.56	5.42	7.02	3
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	8.4	9.57	7.33	12.33	5.5	6.57	8	4.71	9	10.11
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	3.7	0.76	1.63	1.50	1.68	0.96	1.18	0.78	1.13	1.44
$SnO_2/(CeO_2+SnO_2)$	0.55	0.42	0.54	0.63	0.07	0.36	0.67	0.46	0.52	0.31
$R_2O+Li_2O+Al_2O_3$	23.8	27.56	26.9	29.6	18.4	22.6	20.6	25.4	25.8	24.5
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	4.88	4.24	3.84	3.83	5.21	5.1	5.37	3.9	4.25	5.19
Transparent portion $T_{400\text{-}800nm}(\%)$	91.8	92.0	91.6	91.8	92.0	92.0	90.7	91.6	91.8	92.0
Blackened portion $T_{940nm}(\%)$	0.3	21.7	3.3	2.8	4.0	17.1	10.1	2.5	11.1	4.8
Blackened portion $T_{870nm}(\%)$	0.3	7.6	1.2	1.0	1.4	6.0	3.5	0.9	3.9	1.7
Blackened portion $T_{400\text{-}800nm}(\%)$	0	0.7	0.3	0.3	0.3	0.6	0.5	0.3	0.5	0.3
Drop ball test height II (mm)	1200	800	900	800	800	1200	900	1100	800	1200

[0224] Table 10

Example (wt%)	11#	12#	13#	14#	15#	16#	17#	18#	19#	20#
SiO_2	73.78	72.36	76.2	74.27	69.2	72.56	70.4	72.7	76.3	75.4
Al_2O_3	6.9	5.3	3.8	4.9	5.5	4.9	7	7.8	5.4	6.4
Li_2O	7.5	8.3	9.2	9.6	10.4	7.3	11.9	10	10.5	8
K_2O	1.1	3.4	2.4	3	3.8	3.3	4	3.3	1.4	2.3
Na_2O	3.4	3.7	2	2.5	4.4	4.1	1.5	1.3	1.5	2.2

ZrO_2	6.6	6.1	5.6	4.5	6.2	5.3	4.7	4.1	3.9	5.2
CeO_2	0.07	0.13	0.13	0.1	0.09	0.1	0.12	0.11	0.13	0.11
Ag_2O	0.42	0.44	0.3	0.46	0.24	0.37	0.23	0.22	0.32	0.23
Sb_2O_3	0.07	0.1	0.22	0.55	0.07	0.06	0.08	0.45	0.51	0.11
SnO_2	0.16	0.17	0.15	0.12	0.1	0.01	0.07	0.02	0.04	0.05
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	2	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	4.5	7.1	4.4	5.5	8.2	7.4	5.5	4.6	2.9	4.5
SiO_2/Li_2O	9.84	8.72	8.28	7.74	6.65	9.94	5.92	7.27	7.27	9.43
$Sb_2O_3+SnO_2$	0.23	0.27	0.37	0.67	0.17	0.07	0.15	0.47	0.55	0.16
$(Sb_2O_3+SnO_2)/Ag_2O$	0.55	0.61	1.23	1.46	0.71	0.19	0.65	2.14	1.72	0.7
Ag_2O/CeO_2	6	3.38	2.31	4.6	2.67	3.7	1.92	2	2.46	2.09
Li_2O/ZrO_2	1.14	1.36	1.64	2.13	1.68	1.38	2.53	2.44	2.69	1.54
$(K_2O+Na_2O)/ZrO_2$	0.68	1.16	0.79	1.22	1.32	1.4	1.17	1.12	0.74	0.87
$(SiO_2+Li_2O)/ZrO_2$	12.32	13.22	15.25	18.64	12.84	15.07	17.51	20.17	22.26	16.04
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	13.47	10.7	13.02	8.04	18.79	11.28	13.43	12.42	8.67	15.29

$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	9.29	5.46	5.15	11.3	4.56	4.4	3.17	6.27	6.69	3.55
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	0.71	0.91	1.67	1.67	1.08	0.46	1.17	2.64	2.13	1.17
$SnO_2/(CeO_2+SnO_2)$	0.7	0.57	0.54	0.55	0.53	0.09	0.37	0.15	0.24	0.31
$R_2O+Li_2O+Al_2O_3$	18.9	20.7	17.4	20	24.1	19.6	24.4	22.4	18.8	18.9
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	6.72	5.04	5.88	5.24	4.02	5.27	4.45	5.51	6.1	6.54
Transparent portion $T_{400\text{-}800nm}(\%)$	90.7	90.7	91.5	90.7	91.8	92.0	92.0	92.0	92.0	92.0
Blackened portion $T_{940nm}(\%)$	20.7	18.8	4.7	1.0	19.7	35.9	18.3	0.4	0.4	12.8
Blackened portion $T_{870nm}(\%)$	7.3	6.6	1.7	0.4	6.9	12.6	6.4	0.1	0.1	4.5
Blackened portion $T_{400\text{-}800nm}(\%)$	0.7	0.6	0.3	0.2	0.6	1.2	0.6	0	0	0.2
Drop ball test height II (mm)	800	900	900	1000	800	800	800	1200	1100	800

[0225] Table 11

Example (wt%)	21#	22#	23#	24#	25#	26#	27#	28#	29#	30#
SiO_2	72.76	72	72.5	69.8	69.4	73.5	71	71.5	67.5	78
Al_2O_3	5.7	6	6.1	6.5	8.4	7.6	7.9	9.5	6	3
Li_2O	9.2	10.2	9.8	10	12	9.2	11.2	9.8	11.6	11.8
K_2O	4.3	3	3.1	5.2	2.1	2.5	3.7	1.8	3.7	3
Na_2O	1.9	2.5	2.8	5.4	3.3	1.7	4	3.7	4.1	1
ZrO_2	5.5	5.5	4.8	2.4	3.7	4.6	1.6	2.9	6.5	2.1
CeO_2	0.1	0.1	0.15	0.14	0.09	0.1	0.07	0.11	0.12	0.14
Ag_2O	0.29	0.33	0.22	0.21	0.5	0.31	0.3	0.4	0.32	0.4
Sb_2O_3	0.07	0.23	0.42	0.3	0.43	0.29	0.22	0.21	0.14	0.46
SnO_2	0.18	0.14	0.11	0.05	0.08	0.2	0.01	0.08	0.02	0.1
ZnO	0	0	0	0	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0

SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	6.2	5.5	5.9	10.6	5.4	4.2	7.7	5.5	7.8	4
SiO_2/Li_2O	7.91	7.06	7.40	6.98	5.78	7.99	6.34	7.30	5.82	6.61
$Sb_2O_3+SnO_2$	0.25	0.37	0.53	0.35	0.51	0.49	0.23	0.29	0.16	0.56
$(Sb_2O_3+SnO_2)/Ag_2O$	0.86	1.12	2.41	1.67	1.02	1.58	0.77	0.73	0.5	1.4
Ag_2O/CeO_2	2.9	3.3	1.47	1.5	5.56	3.1	4.29	3.64	2.67	2.86
Li_2O/ZrO_2	1.67	1.85	2.04	4.17	3.24	2	7	3.38	1.78	5.62
$(K_2O+Na_2O)/ZrO_2$	1.13	1	1.23	4.42	1.46	0.91	4.81	1.9	1.2	1.9
$(SiO_2+Li_2O)/ZrO_2$	14.9	14.95	17.15	33.25	22	17.98	51.38	28.03	12.17	42.76
MO/ZrO_2	0	0	0	0	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	14.1	12.79	12.97	6.86	6.27	11.22	4.32	5.69	14.77	3.89
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	5.4	7	5	4	11.22	8	7.57	6.27	4	6.86
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	1.21	1.42	3.09	2.33	1.2	1.9	1	1	0.88	1.75
$SnO_2/(CeO_2+SnO_2)$	0.64	0.58	0.42	0.26	0.47	0.67	0.13	0.42	0.14	0.42
$R_2O+Li_2O+Al_2O_3$	21.1	21.7	21.8	27.1	25.8	21	26.8	24.8	25.4	18.8
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.09	4.97	5.01	3.7	4.47	6.05	4.17	5.29	3.79	5.13
Transparent portion $T_{400\text{-}800nm}(\%)$	90.8	91.6	91.6	92.0	92.0	90.5	92.0	92.0	92.0	90.5
Blackened portion $T_{940nm}(\%)$	12.6	7.0	7.9	2.1	6.4	0.9	17.0	17.5	24.6	0.5
Blackened portion $T_{870nm}(\%)$	4.4	2.5	2.8	0.7	2.2	0.3	6.0	6.2	8.6	0.2

Blackened portion $T_{400\text{-}800nm}$(%)	0.2	0.4	0.4	0.3	0.4	0.1	0.6	0.6	0.7	0
Drop ball test height II (mm)	1200	1200	1100	800	800	1200	900	1200	800	1000

[0226] Table 12

Example (wt%)	31#	32#	33#	34#	35#	36#	37#	38#	39#	40#
SiO_2	71.1	70.9	73.5	72.3	74.2	72.5	72.1	72.9	70.1	70.5
Al_2O_3	8.9	8.4	3.5	7.6	5.9	6	6	4.8	9.7	8
Li_2O	8.5	10.2	11	9.6	9.8	10.4	10.7	10.8	7.4	11.6
K_2O	1.8	3.2	3.8	2.3	3.2	3.4	4.5	3.7	4.6	1.1
Na_2O	5.5	1.9	3.2	1.1	2.9	2.1	2.8	3.9	1.3	2.5
ZrO_2	2	4.8	4.3	2	3.4	5.1	3	3.4	6.1	5.4
CeO_2	0.15	0.12	0.09	0.15	0.09	0.1	0.11	0.1	0.13	0.13
Ag_2O	0.36	0.24	0.23	0.34	0.29	0.22	0.3	0.25	0.24	0.3
Sb_2O_3	0.5	0.21	0.31	0.43	0.15	0.08	0.39	0.14	0.35	0.44
SnO_2	0.09	0.03	0.07	0.18	0.07	0.1	0.1	0.01	0.08	0.03
ZnO	1.1	0	0	4	0	0	0	0	0	0
MgO	0	0	0	0	0	0	0	0	0	0
CaO	0	0	0	0	0	0	0	0	0	0
SrO	0	0	0	0	0	0	0	0	0	0
BaO	0	0	0	0	0	0	0	0	0	0
La_2O_3	0	0	0	0	0	0	0	0	0	0
Gd_2O_3	0	0	0	0	0	0	0	0	0	0
Y_2O_3	0	0	0	0	0	0	0	0	0	0
Fe_2O_3	0	0	0	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100	100	100	100
R_2O	7.3	5.1	7	3.4	6.1	5.5	7.3	7.6	5.9	3.6

SiO_2/Li_2O	8.36	6.95	6.68	7.53	7.57	6.97	6.74	6.75	9.47	6.08
$Sb_2O_3+SnO_2$	0.59	0.24	0.38	0.61	0.22	0.18	0.49	0.15	0.43	0.47
$(Sb_2O_3+SnO_2)/Ag_2O$	1.64	1	1.65	1.79	0.76	0.82	1.63	0.60	1.79	1.57
Ag_2O/CeO_2	2.4	2	2.56	2.27	3.22	2.2	2.73	2.5	1.85	2.31
Li_2O/ZrO_2	4.25	2.13	2.56	4.8	2.88	2.04	3.57	3.18	1.21	2.15
$(K_2O+Na_2O)/ZrO_2$	3.65	1.06	1.63	1.7	1.79	1.08	2.43	2.24	0.97	0.67
$(SiO_2+Li_2O)/ZrO_2$	39.8	16.9	19.65	40.95	24.71	16.25	27.6	24.62	12.7	15.2
MO/ZrO_2	0.55	0	0	2	0	0	0	0	0	0
$ZrO_2/(Ag_2O+CeO_2)$	3.92	13.33	13.44	4.08	8.95	15.94	7.32	9.71	16.49	12.56
$(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$	6.33	4	6.78	6.33	5.67	4	7.18	4	5.15	5.92
$(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$	2.06	1.5	2.04	2.24	1.07	1.27	2	1	2.33	2
$SnO_2/(CeO_2+SnO_2)$	0.38	0.2	0.44	0.55	0.44	0.5	0.48	0.09	0.38	0.19
$R_2O+Li_2O+Al_2O_3$	24.7	23.7	21.5	20.6	21.8	21.9	24	23.2	23	23.2
$(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$	5.06	5.18	4.28	6.15	5.04	4.94	4.34	4.22	6	5.16
Transparent portion $T_{400\text{-}800nm}(\%)$	91.8	92.0	92.0	90.8	92.0	92.0	92.0	92.0	92.0	92.0
Blackened portion $T_{940nm}(\%)$	0.3	7.1	0.5	0.9	22.7	9.7	0.7	21.7	0.3	1.0
Blackened portion $T_{870nm}(\%)$	0.1	2.5	0.2	0.3	8.0	3.4	0.2	7.6	0.1	0.3
Blackened portion $T_{400\text{-}800nm}(\%)$	0	0.4	0	0	0.7	0.2	0	0.7	0	0.1
Drop ball test height II (mm)	1200	1100	1000	900	800	800	800	800	800	800

CLAIMS:

1. A microcrystalline glass product comprising following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, and Ag_2O: 0.01% to 0.8%, wherein R_2O is one or both of Na_2O and K_2O.

2. The microcrystalline glass product according to claim 1, further comprising following components in percentage by weight: Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%, wherein MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

3. The microcrystalline glass product according to claim 1 or 2, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 5.5 to 10.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1;

4) Ag_2O/CeO_2 is in a range from 1.0 to 10.0;

5) Li_2O/ZrO_2 is in a range from 1.0 to 7.5;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5;

13) MO/ZrO_2 is equal to or less than 2.5;

14) $Sb_2O_3+SnO_2$: 0.05% to 1.2%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

4. The microcrystalline glass product according to claim 1 or 2, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 6.0 to 9.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5;

4) Ag_2O/CeO_2 is in a range from 1.5 to 6.5;

5) Li_2O/ZrO_2 is in a range from 1.2 to 5.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5;

13) MO/ZrO_2 is less than or equal to 1.5;

14) $Sb_2O_3+SnO_2$: 0.1% to 1%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

5. The microcrystalline glass product according to claim 1 or 2, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 7.0 to 8.5;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5;

4) Ag_2O/CeO_2 is in a range from 2.0 to 4.5;

5) Li_2O/ZrO_2 is in a range from 1.6 to 3.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8;

13) MO/ZrO_2 is less than or equal to 0.5;

14) $Sb_2O_3+SnO_2$: 0.2% to 0.7%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

6. The microcrystalline glass product according to claim 1 or 2, wherein the components in percentage by weight satisfy: SiO_2: 69.5% to 75.5%, and/or R_2O: 4% to 8%, and/or Li_2O: 8.5% to 12%, and/or Al_2O_3: 5% to 9%, and/or ZrO_2: 3% to 6.5%, and/or CeO_2: 0.08% to 0.3%, and/or Ag_2O: 0.2% to 0.5%, and/or Sb_2O_3: 0.07% to 0.5%, and/or SnO_2: 0% to 0.2%, and/or MO: 0% to 1%, and/or Ln_2O_3: 0% to 1%, and/or Fe_2O_3: 0% to 0.2%, wherein R_2O is one or both of Na_2O and K_2O, MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

7. The microcrystalline glass product according to claim 1 or 2, wherein the microcrystalline glass product comprises one or more blackened portions and one or more transparent portions; or the microcrystalline glass product as a whole is a blackened portion.

8. The microcrystalline glass product according to claim 7, wherein the microcrystalline glass product contains a lithium metasilicate crystalline phase, and in the blackened portion of the microcrystalline glass product, a weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50%.

9. The microcrystalline glass product according to claim 7, wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is greater than or equal to 88.0%, and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 3.0%, and/or a transmittance T_{870nm} of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is in a range from 0.1% to 12.5%, and/or a transmittance T_{940nm} of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is in a range from 0.1% to 35.0%, and/or the ball drop test height II of the microcrystalline glass product is greater than or equal to 900 mm.

10. The microcrystalline glass product according to claim 7, wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is in a range from 91.5% to 95.0%, and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 0.5%, and/or a transmittance T_{870nm} of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is in a range from 0.1% to 5.0%, and/or a transmittance T_{940nm} of the blackened portion of the microcrystalline glass product with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is in a range from 0.3% to 10.0%, and/or the ball drop test height II of the microcrystalline glass product is greater than or equal to 1100 mm.

11. A microcrystalline glass comprising following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, and Ag_2O: 0.01% to 0.8%, wherein R_2O is one or both of Na_2O and K_2O.

12. The microcrystalline glass according to claim 11, further comprising following components in percentage by weight: Sb_2O_3: 0% to 1%, and/or SnO_2: 0% to 0.5%, and/or MO: 0% to 5%, and/or Ln_2O_3: 0% to 5%, and/or Fe_2O_3: 0% to 1%, wherein MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

13. The microcrystalline glass according to claim 11 or 12, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 5.5 to 10.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1;

4) Ag_2O/CeO_2 is in a range from 1.0 to 10.0;

5) Li_2O/ZrO_2 is in a range from 1.0 to 7.5;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5;

13) MO/ZrO_2 is less than or equal to 2.5;

14) $Sb_2O_3+SnO_2$: 0.05% to 1.2%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

14. The microcrystalline glass according to claim 11 or 12, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 6.0 to 9.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5;

4) Ag_2O/CeO_2 is in a range from 1.5 to 6.5;

5) Li_2O/ZrO_2 is in a range from 1.2 to 5.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5;

13) MO/ZrO_2 is less than or equal to 1.5;

14) $Sb_2O_3+SnO_2$: 0.1% to 1%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

15. The microcrystalline glass according to claim 11 or 12, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 7.0 to 8.5;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5;

4) Ag_2O/CeO_2 is in a range from 2.0 to 4.5;

5) Li_2O/ZrO_2 is in a range from 1.6 to 3.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8;

13) MO/ZrO_2 is less than or equal to 0.5;

14) $Sb_2O_3+SnO_2$: 0.2% to 0.7%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

16. The microcrystalline glass according to claim 11 or 12, wherein the components in percentage by weight satisfy: SiO_2: 69.5% to 75.5%, and/or R_2O: 4% to 8%, and/or Li_2O: 8.5% to 12%, and/or Al_2O_3: 5% to 9%, and/or ZrO_2: 3% to 6.5%, and/or CeO_2: 0.08% to 0.3%, and/or Ag_2O: 0.2% to 0.5%, and/or Sb_2O_3: 0.07% to 0.5%, SnO_2: 0% to 0.2%, and/or MO: 0% to 1%, and/or Ln_2O_3: 0% to 1%, and/or Fe_2O_3: 0% to 0.2%, wherein R_2O is one or both of Na_2O and K_2O, MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

17. The microcrystalline glass according to claim 11 or 12, wherein the microcrystalline glass comprises one or more blackened portions and one or more transparent portions; or the microcrystalline glass as a whole is a blackened portion.

18. The microcrystalline glass according to claim 17, wherein the microcrystalline glass contains a lithium metasilicate crystalline phase, and in the blackened portion of the microcrystalline glass, the weight percentage of the lithium metasilicate crystalline phase is in a range from 5% to 50%.

19. The microcrystalline glass according to claim 17, wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is greater than or equal to 88.0%, and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 3.0%, and/or a transmittance T_{870nm} of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is in a range from 0.1% to 12.5%, and/or a transmittance T_{940nm} of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is in a range from 0.1% to 35.0%.

20. The microcrystalline glass according to claim 17, wherein an average transmittance $T_{400\text{-}800nm}$ of the transparent portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is in a range from 91.5% to 95.0%, and/or an average transmittance $T_{400\text{-}800nm}$ of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm in a wavelength range from 400 nm to 800 nm is less than or equal to 0.5%, and/or a transmittance T_{870nm} of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 870 nm is in a range from 0.1% to 5.0%, and/or a transmittance T_{940nm} of the blackened portion of the microcrystalline glass with a thickness of 0.2 mm to 1.5 mm at a wavelength of 940 nm is in a range from 0.3% to 10.0%.

21. A matrix glass, comprising following components in percentage by weight: SiO_2: 65% to 78%, R_2O: 2% to 12%, Li_2O: 5% to 15%, Al_2O_3: 3% to 12%, ZrO_2: 1.5% to 10%, CeO_2: 0.01% to 0.6%, Ag_2O: 0.01% to 0.8%, Sb_2O_3: 0% to 1%, SnO_2: 0% to 0.5%, MO: 0% to 5%, Ln_2O_3: 0% to 5%, and Fe_2O_3: 0% to 1%, wherein R_2O is one or both of Na_2O and K_2O; MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

22. The matrix glass according to claim 21, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 5.5 to 10.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.1 to 5.0;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.5 to 7.1;

4) Ag_2O/CeO_2 is in a range from 1.0 to 10.0;

5) Li_2O/ZrO_2 is in a range from 1.0 to 7.5;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 8.0 to 55.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 2.3 to 50.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 1.0 to 30.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.1 to 10.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.9;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 15% to 30%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.0 to 7.5;

13) MO/ZrO_2 is less than or equal to 2.5;

14) $Sb_2O_3+SnO_2$: 0.05% to 1.2%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

23. The matrix glass according to claim 21, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 6.0 to 9.0;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 0.5 to 3.5;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.7 to 4.5;

4) Ag_2O/CeO_2 is in a range from 1.5 to 6.5;

5) Li_2O/ZrO_2 is in a range from 1.2 to 5.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 10.0 to 37.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 6.5 to 35.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 3.0 to 20.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 0.4 to 5.0;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.6;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 17.5% to 29.5%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 3.7 to 6.5;

13) MO/ZrO_2 is less than or equal to 1.5;

14) $Sb_2O_3+SnO_2$: 0.1% to 1%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

24. The matrix glass according to claim 21, wherein the components in percentage by weight satisfy one or more of following 14 conditions:

1) SiO_2/Li_2O is in a range from 7.0 to 8.5;

2) $(Sb_2O_3+SnO_2)/Ag_2O$ is in a range from 1.0 to 2.6;

3) $(K_2O+Na_2O)/ZrO_2$ is in a range from 0.8 to 2.5;

4) Ag_2O/CeO_2 is in a range from 2.0 to 4.5;

5) Li_2O/ZrO_2 is in a range from 1.6 to 3.0;

6) $(SiO_2+Li_2O)/ZrO_2$ is in a range from 13.0 to 20.0;

7) $ZrO_2/(Ag_2O+CeO_2)$ is in a range from 11.0 to 18.0;

8) $(Ag_2O+SnO_2+Sb_2O_3)/CeO_2$ is in a range from 7.5 to 10.0;

9) $(Sb_2O_3+SnO_2+CeO_2)/Ag_2O$ is in a range from 1.5 to 3.2;

10) $SnO_2/(CeO_2+SnO_2)$ is in a range from 0 to 0.5;

11) $R_2O+Li_2O+Al_2O_3$ is in a range from 20% to 25%;

12) $(SiO_2+Al_2O_3)/(Li_2O+Na_2O+K_2O)$ is in a range from 4.8 to 5.8;

13) MO/ZrO_2 is less than or equal to 0.5;

14) $Sb_2O_3+SnO_2$: 0.2% to 0.7%, wherein R_2O is one or both of Na_2O and K_2O, and MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO.

25. The matrix glass according to claim 21, wherein the components in percentage by weight satisfy: SiO_2: 69.5% to 75.5%, and/or R_2O: 4% to 8%, and/or Li_2O: 8.5% to 12%, and/or Al_2O_3: 5% to 9%; and/or ZrO_2: 3% to 6.5%, and/or CeO_2: 0.08% to 0.3%, and/or Ag_2O: 0.2% to 0.5%, and/or Sb_2O_3: 0.07% to 0.5%, and/or SnO_2: 0% to 0.2%, and/or MO: 0% to 1%, and/or Ln_2O_3: 0% to 1%; and/or Fe_2O_3: 0% to 0.2%, wherein R_2O is one or both of Na_2O and K_2O, MO is one or more selected from the group consisting of MgO, CaO, SrO, BaO, and ZnO, and Ln_2O_3 is one or more selected from the group consisting of La_2O_3, Gd_2O_3, and Y_2O_3.

26. The matrix glass according to claim 21, wherein a refractive index n_d of the matrix glass is in a range from 1.51 to 1.55, and/or Young's modulus E of the matrix glass is in a range from 7000×10^7 Pa to 9500×10^7 Pa, and/or Knoop hardness $Hk_{0.1}$ is greater than or equal to 450 kgf/mm^2, and/or a drop ball test height I is greater than or equal to 200 mm, and/or a dielectric loss tanδ is less than or equal to 11.0×10^{-3}, and/or a dielectric constant ε_r is in a range from 5.5 to 8.5, and/or a coefficient of linear expansion $\alpha_{20℃\text{-}300℃}$ is less than or equal to 100×10^{-7}/℃.

27. A glass cover plate, comprising the microcrystalline glass product according to any one of claims 1 to 10, and/or the microcrystalline glass according to any one of claims 11 to 20, and/or the matrix glass according to any one of claims 21 to 26.

28. A device, comprising the microcrystalline glass product according to any one of claims 1 to 10, and/or the microcrystalline glass according to any one of claims 11 to 20, and/or the matrix glass according to any one of claims 21 to 26, and/or the glass cover plate according to claim 27.