[0003] PTL 1: Japanese Unexamined Patent Publication (KOKAI) No. 2010-64921

Summary ~~of Invention~~

[0003a] In a first aspect of the present disclosure, there is provided a glass for magnetic recording medium substrate,

which is an amorphous oxide glass,

wherein, in terms of mol%:

an SiO_2 content ranges from 52 to 68%;

an Al_2O_3 content ranges from 12 to 18%;

a total content of SiO_2 and Al_2O_3 ($SiO_2 + Al_2O_3$) is equal to or less than 80%;

a B_2O_3 content ranges from 0 to 5%;

an MgO content ranges from 20.80 to 28%;

a CaO content ranges from 0 to 18%;

a TiO_2 content ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a total content of BaO and SrO (BaO + SrO) ranges from 0 to 2%;

a total content of alkali earth metal oxides (MgO + CaO + SrO + BaO) ranges from 12 to 30%;

a molar ratio of a total content of MgO and CaO relative to the total content of alkali earth metal oxides {(MgO + CaO)/(MgO + CaO + SrO + BaO)} ranges from 0.75 to 1.00;

a total content of alkali metal oxides ($Li_2O + Na_2O + K_2O$) ranges from 3.5 to 13%;

a molar ratio of Li_2O content relative to the total content of alkali metal oxides {Li_2O/($Li_2O + Na_2O + K_2O$)} ranges from 0.4 to 1;

a Li_2O content is equal to or less than 8%;

a Na_2O content is equal to or less than 6%;

a K_2O content is equal to or less than 5%;

TiO_2 content ranges from 0 to 5%;

a total content of HfO_2, Nb_2O_5, Ta_2O_5, La_2O_3 and Y_2O_3 ($HfO_2 + Nb_2O_5 + Ta_2O_5 + La_2O_3 + Y_2O_3$) ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a ZnO content ranges from 0 to 3%; and

a P_2O_5 content ranges from 0 to 2%.

[0003b] In another aspect of the present disclosure, there is provided a glass for magnetic recording medium substrate,

which is an amorphous oxide glass,

wherein, in terms of mol%:

an SiO_2 content ranges from 52 to 68%;

an Al_2O_3 content ranges from 12 to 18%;

a total content of SiO_2 and Al_2O_3 ($SiO_2 + Al_2O_3$) is equal to or less than 80%;

a B_2O_3 content ranges from 0 to 5%;

an MgO content ranges from 3 to 28%;

a CaO content ranges from 0 to 4.00%;

a TiO_2 content ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a total content of BaO and SrO (BaO + SrO) ranges from 0 to 2%;

a total content of alkali earth metal oxides (MgO + CaO + SrO + BaO) ranges from 12 to 30%;

a molar ratio of a total content of MgO and CaO relative to the total content of alkali earth metal oxides {(MgO + CaO)/(MgO + CaO + SrO + BaO)} ranges from 0.75 to 1.00;

a total content of alkali metal oxides ($Li_2O + Na_2O + K_2O$) ranges from 3.5 to 13%;

a molar ratio of Li_2O content relative to the total content of alkali metal oxides {Li_2O/(Li_2O + Na_2O + K_2O)} ranges from 0.4 to 1;

a Li_2O content is equal to or less than 8%;

a Na_2O content is equal to or less than 6%;

a K_2O content is equal to or less than 5%;

TiO_2 content ranges from 0 to 5%;

a total content of HfO_2, Nb_2O_5, Ta_2O_5, La_2O_3 and Y_2O_3 (HfO_2 + Nb_2O_5 + Ta_2O_5 + La_2O_3 + Y_2O_3) ranges from 0 to 3%;

a ZrO_2 content ranges from 0 to 3%;

a ZnO content ranges from 0 to 3%; and

a P_2O_5 content ranges from 0 to 2%.

[0003c] In yet another aspect of the present disclosure, there is provided a magnetic recording medium substrate, which is comprised of the glass for magnetic recording medium substrate as disclosed herein.

[0003d] In a further aspect of the present disclosure, there is provided a magnetic recording medium, which comprises a magnetic recording layer on the magnetic recording medium substrate as disclosed herein.

[0003e] In another aspect of the present disclosure, there is provided a magnetic recording and reproducing apparatus, which comprises the magnetic recording medium as disclosed herein.

Technical Problem

[0004] In a process of forming a magnetic recording layer on a magnetic recording medium substrate, film formation at a high temperature is usually performed or a heat treatment at a high temperature is performed after film formation. Accordingly, a glass for magnetic recording medium substrate is required to have high heat resistance capable of withstanding a high temperature treatment, specifically to have a high glass transition temperature.

[0005] On the other hand, a magnetic recording and reproducing apparatus incorporated with a magnetic recording medium (generally referred to as a HDD (hard disk drive)) has a structure in which the center portion is pressed down with a spindle of a spindle motor and a clamp and the magnetic recording medium itself is rotated. As a consequence, when there is a large difference between respective thermal expansion coefficients of a magnetic recording medium substrate and a spindle material constituting the spindle portion, deviation occurs during use between thermal expansion/ thermal contraction of the spindle and thermal expansion/ thermal contraction of the magnetic recording medium substrate relative to ambient temperature change. As a result, a phenomenon such as deformation of the magnetic recording medium is generated. When the phenomenon is generated, a head cannot read written information to cause deterioration of reliability on recording/ reproduction.

CLAIMS

1. A glass for magnetic recording medium substrate,

which is an amorphous oxide glass,

wherein, in terms of mol%:

an SiO_2 content ranges from ~~45~~ 52 to 68%;

an Al_2O_3 content ranges from ~~5~~ 12 to ~~20~~18%;

a total content of SiO_2 and Al_2O_3 ($SiO_2 + Al_2O_3$) ~~ranges from 60 to~~ is equal to or less than 80%;

a B_2O_3 content ranges from 0 to 5%;

an MgO content ranges from 20.80~~3~~ to 28%;

a CaO content ranges from 0 to 18%;

a TiO_2 content ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a total content of BaO and SrO (BaO + SrO) ranges from 0 to 2%;

a total content of alkali earth metal oxides (MgO + CaO + SrO + BaO) ranges from 12 to 30%;

a molar ratio of a total content of MgO and CaO relative to the total content of alkali earth metal oxides {(MgO + CaO)/(MgO + CaO + SrO + BaO)} ranges from 0.75 to 1.00;

a total content of alkali metal oxides ($Li_2O + Na_2O + K_2O$) ranges from 3.5 to 13~~15~~%;

a molar ratio of Li_2O content relative to the total content of alkali metal oxides {Li_2O/($Li_2O + Na_2O + K_2O$)} ranges from 0.4 to 1;

a Li_2O content is equal to or less than 8%;

a Na_2O content is equal to or less than 6%;

a K_2O content is equal to or less than 5%;

TiO_2 content ranges from 0 to 5%;

a total content of HfO_2, Nb_2O_5, Ta_2O_5, La_2O_3 and Y_2O_3 ($HfO_2 + Nb_2O_5 + Ta_2O_5 + La_2O_3 + Y_2O_3$) ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a ZnO content ranges from 0 to 3%; and

a P_2O_5 content ranges from 0 to 2%.

~~at least one kind selected from the group consisting of Sn oxide and Ce oxide being included, a total content of Sn oxide and Ce oxide ranges from 0.05 to 2.00%,~~

~~a glass transition temperature is equal to or higher than 625°C;~~

~~a Young's modulus is equal to or more than 83 GPa;~~

~~a specific gravity is equal to or less than 2.85; and~~

~~an average linear expansion coefficient at 100 to 300°C is equal to or more than 48×10^{-7}/°C.~~

2. The glass for magnetic recording medium substrate according to claim 1,

wherein the CaO content ranges from 0 to 4.00%, and the total content of HfO_2, Nb_2O_5, Ta_2O_5, La_2O_3 and Y_2O_3 ($HfO_2 + Nb_2O_5 + Ta_2O_5 + La_2O_3 + Y_2O_3$) ranges from 0 to 3%.

3. A glass for magnetic recording medium substrate,

which is an amorphous oxide glass,

wherein, in terms of mol%:

an SiO_2 content ranges from 52 to 68%;

an Al_2O_3 content ranges from 12 to 18%;

a total content of SiO_2 and Al_2O_3 ($SiO_2 + Al_2O_3$) is equal to or less than 80%;

a B_2O_3 content ranges from 0 to 5%;

an MgO content ranges from 3 to 28%;

a CaO content ranges from 0 to 4.00%;

a TiO_2 content ranges from 0 to 5%;

a ZrO_2 content ranges from 0 to 3%;

a total content of BaO and SrO (BaO + SrO) ranges from 0 to 2%;

a total content of alkali earth metal oxides (MgO + CaO + SrO + BaO) ranges from 12 to 30%;

a molar ratio of a total content of MgO and CaO relative to the total content of alkali earth metal oxides {(MgO + CaO)/(MgO + CaO + SrO + BaO)} ranges from 0.75 to 1.00;

a total content of alkali metal oxides (Li_2O + Na_2O + K_2O) ranges from 3.5 to 13%;

a molar ratio of Li_2O content relative to the total content of alkali metal oxides {Li_2O/(Li_2O + Na_2O + K_2O)} ranges from 0.4 to 1;

a Li_2O content is equal to or less than 8%;

a Na_2O content is equal to or less than 6%;

a K_2O content is equal to or less than 5%;

TiO_2 content ranges from 0 to 5%;

a total content of HfO_2, Nb_2O_5, Ta_2O_5, La_2O_3 and Y_2O_3 (HfO_2 + Nb_2O_5 + Ta_2O_5 + La_2O_3 + Y_2O_3) ranges from 0 to 3%;

a ZrO_2 content ranges from 0 to 3%;

a ZnO content ranges from 0 to 3%; and

a P_2O_5 content ranges from 0 to 2%.

4. The glass for magnetic recording medium substrate according to any of claims 1 to 3,

wherein a specific elastic modulus is equal to or more than 31 MNm/kg.

5. The glass for magnetic recording medium substrate according to any of claims 1 to 4,

wherein no crystals are confirmed by magnification observation, magnifying power of 40 to 100, with an optical microscope after the glass is left to stand for 16 hours with a temperature of 1250°C kept, and then cooled to room temperature.

6. The glass for magnetic recording medium substrate according to any of claims 1 to 5,

wherein a bubble density per unit mass is less than 50/kg, as a density of bubbles each having a diameter exceeding 0.03 mm when observation is performed with an optical microscope at magnifications from 40 to 100.

~~2. The glass for magnetic recording medium substrate according to claim 1,~~

~~wherein a content of Li_2O ranges from 0 to 8 mol%;~~

~~a content of Na_2O ranges from 0 to 10 mol%; and~~

~~a content of K_2O ranges from 0 to 5 mol%.~~

~~3. The glass for magnetic recording medium substrate according to claim 1 or 2,~~

~~which comprises Sn oxide and Ce oxide.~~

~~4. The glass for magnetic recording medium substrate according to any of claims 1 to 3,~~

~~wherein a molar ratio of a total content of MgO and CaO relative to a total content of alkali earth metal oxides {(MgO + CaO)/(MgO + CaO + SrO + BaO)} ranges from 0.75 to 1.00.~~

~~5~~7. A magnetic recording medium substrate, which is comprised of the glass for magnetic recording medium substrate according to any of claims 1 to ~~6~~4.

~~6~~8. A magnetic recording medium, which comprises a magnetic recording layer on the magnetic recording medium substrate according to claim ~~5~~7.

9. A magnetic recording and reproducing apparatus,

which comprises the magnetic recording medium according to claim 8.

~~7. A glass spacer for magnetic recording and reproducing apparatus,~~

~~which is an amorphous oxide glass,~~

~~wherein, in terms of mol%:~~

~~an SiO_2 content ranges from 45 to 68%;~~

~~an Al_2O_3 content ranges from 5 to 20%;~~

~~a total content of SiO_2 and Al_2O_3 ($SiO_2 + Al_2O_3$) ranges from 60 to 80%;~~

~~a B_2O_3 content ranges from 0 to 5%;~~

~~an MgO content ranges from 3 to 28%;~~

~~a CaO content ranges from 0 to 18%;~~

~~a total content of BaO and SrO (BaO + SrO) ranges from 0 to 2%;~~

~~a total content of alkali earth metal oxides (MgO + CaO + SrO + BaO) ranges from 12 to 30%;~~

~~a total content of alkali metal oxides ($Li_2O + Na_2O + K_2O$) ranges from 3.5 to 15%; and~~

~~at least one kind selected from the group consisting of Sn oxide and Ce oxide being included, a total content of Sn oxide and Ce oxide ranges from 0.05 to 2.00%,~~

~~a glass transition temperature is equal to or higher than 625°C;~~

~~a Young's modulus is equal to or more than 83 GPa;~~

~~a specific gravity is equal to or less than 2.85; and~~

~~an average linear expansion coefficient at 100 to 300°C is equal to or more than 48×10^{-7}/°C.~~