Claims

~~1. A vacuum glass, comprising:~~

~~a glass body (1), a cavity (5) enclosed by said glass body (1) and a sealant (4) together, and a getter (3) disposed in said cavity (5);~~

~~said cavity (5) is hermetic therein;~~

~~the getter (3) is a non-evaporable getter, and said vacuum glass does not comprise an enclosure for enclosing the getter (3), and said enclosure is made of a hermetic material;~~

~~in a direction passing through said cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 4 W/(m^2·K).~~

~~2. The vacuum glass according to claim 1, characterized in one or more of the following,~~

~~preferably, said vacuum glass does not comprise a sealed evacuation port;~~

~~preferably, said glass body (1) does not have a sealed evacuation port thereon;~~

~~preferably, said sealant (4) does not have a sealed evacuation port thereon;~~

~~preferably, said vacuum glass does not have a sealing device for sealing the evacuation port;~~

~~preferably, said vacuum glass comprises at least two glass bodies (1);~~

~~preferably, said vacuum glass comprises at least three glass bodies (1); and~~

~~preferably, adjacent glass bodies (1) are bonded by the sealant (4).~~

~~3. The vacuum glass according to claim 1, wherein said glass body (1) comprises a plate-like glass body;~~

~~preferably, said glass body (1) comprises at least two plate-like glass bodies;~~

~~preferably, said plate-like glass bodies face each other;~~

~~preferably, said plate-like glass bodies are parallel to each other.~~

~~4. The vacuum glass according to claim 1, characterized in one or more of the following,~~

~~preferably, said glass body (1) comprises a glass tube;~~

~~preferably, said glass body (1) comprises a glass plate;~~

~~preferably, said glass plate is a planar glass plate or a curved glass plate.~~

~~5. The vacuum glass according to claim 1, characterized in one or more of the following,~~

~~preferably, a plated film or a pasted file is provided on at least one glass body~~

~~(1);~~

~~preferably, said glass body (1) has a flat surface;~~

~~preferably, said glass body (1) does not have a groove thereon;~~

~~preferably, said glass body (1) is formed of silicate glass;~~

~~preferably, said glass body (1) has a softening point higher than 550 °C;~~

~~preferably, said glass body (1) has a softening point higher than 650 °C;~~

~~preferably, said glass body (1) has a softening point higher than 750 °C;~~

~~preferably, said cavity (5) is a plate-like cavity;~~

~~preferably, said vacuum glass comprises at least one cavity (5);~~

~~preferably, said vacuum glass comprises at least two cavities (5); and~~

~~preferably, the sealant (4) and the glass body (1) are welded together.~~

~~6. The vacuum glass according to claim 1, wherein said sealant (4) comprises sealing glass;~~

~~preferably, the sealing glass comprises a glass selected from PbO-ZnO-B_2O_3 system, Bi_2O_3-B_2O_3-SiO_2 system, Bi_2O_3-B_2O_3-ZnO system, Na_2O-Al_2O_3-B_2O_3 system, SnO-ZnO-P_2O_5 system, V_2O_5-P_2O_5-Sb_2O_3 system, ZnO-B_2O_3-SiO_2 system and ZnO-B_2O_3-BaO system;~~

~~preferably, the sealing glass has a sealing temperature less than 500 °C;~~

~~preferably, the sealing glass has a sealing temperature of 300-450 °C; and~~

~~preferably, the sealing glass has a sealing temperature of 400-450 °C.~~

~~7. The vacuum glass according to claim 1, characterized in one or more of the following,~~

~~preferably, said getter (3) is an activated getter;~~

~~preferably, said getter (3) is capable of absorbing one or more gases selected from O_2, N_2, CO_2, CO and H_2;~~

~~preferably, said getter (3) comprises an elementary substance with gettering ability, an alloy with gettering ability, a compound with gettering ability or a mixture with gettering ability;~~

~~preferably, said getter (3) contains zirconium element or titanium element;~~

~~preferably, said getter (3) contains one or more transition metal elements;~~

~~preferably, said getter (3) contains one or more rare earth metal elements;~~

~~preferably, said getter (3) is a Zr-Al type getter or a Zr-V-Fe type getter;~~

~~preferably, said getter (3) is in said cavity (5) in a density of 0.1g/cm^3 or more;~~

~~preferably, said getter (3) is in said cavity (5) in a density of 0.5g/cm^3 or more;~~

preferably, said getter (3) is in said cavity (5) in a density of 1g/cm^3 or more;

preferably, said getter (3) has an activation temperature less than or equal to the sealing temperature of the sealant (4);

preferably, said getter (3) is capable of being activated at 300-450 °C;

preferably, said getter (3) is capable of being activated by vacuum thermal treatment at 300 °C or more for 1 hour or more, or

said getter (3) is capable of being activated by heat treatment in vacuum at 350 °C or more for more than 0.5 hours, or

said getter (3) is capable of being activated by heat treatment in vacuum at 400 °C or more for 10 minutes or more.

8. The vacuum glass according to claim 1, wherein said vacuum glass further comprises a support (2) for supporting said glass body (1) so as to maintain the shape of the cavity (5);

preferably, said support (2) is disposed in said cavity (5);

preferably, said support (2) is made of a metallic material or a non-metallic material;

preferably, said support (2) is made of a transparent inorganic substance;

preferably, said support (2) is made of glass (for example, quartz glass or sapphire glass);

preferably, said support (2) is a glass sheet; and

preferably, said support (2) is a circular glass sheet, an elliptical glass sheet or a polygonal glass sheet.

9. The vacuum glass according to claim 1, wherein said vacuum glass is transparent;

preferably, in at least one direction, more than 85% of the total area of said vacuum glass is transparent;

preferably, in at least one direction, more than 90% of the total area of said vacuum glass is transparent; and

preferably, in at least one direction, more than 95% of the total area of said vacuum glass is transparent.

10. The vacuum glass according to claim 1, wherein on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 3 W/(m^2·K);

preferably, on a direction passing through the cavity (5), said vacuum glass has a

~~thermal conductivity value K less than or equal to 2.5 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 2 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 1.8 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 1.6 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 1.4 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 1.2 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 1 W/(m^2·K);~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 0.8 W/(m^2·K); and~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 0.6 W/(m^2·K).~~

~~11. The vacuum glass according to claim 1, wherein on a direction passing through the cavity (5), said vacuum glass has a sound insulation value R_w+C_{tr} of is 10dB or more;~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a sound insulation value R_w+C_{tr} of 20dB or more;~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a sound insulation value R_w+C_{tr} of 30dB or more; and~~

~~preferably, on a direction passing through the cavity (5), said vacuum glass has a sound insulation value R_w+C_{tr} of 30-35dB.~~

~~12. The vacuum glass according to claim 1, wherein the direction passing through said cavity (5) is the thickness direction of the vacuum glass.~~

~~13. The vacuum glass according to claim 1, wherein in at least one direction, said glass body (1) has a size greater than or equal to 0.01m;~~

~~preferably, in at least one direction, said glass body (1) has a size greater than or equal to 0.05m;~~

~~preferably, in at least one direction, said glass body (1) has a size greater than or equal to 0.1m;~~

preferably, in at least one direction, said glass body (1) has a size greater than or equal to 0.3m;

preferably, in at least one direction, said glass body (1) has a size greater than or equal to 0.5m; and

preferably, in at least one direction, said glass body (1) has a size greater than or equal to 1m.

14. The vacuum glass according to claim 1, wherein in two directions perpendicular to each other, said glass body (1) has a size greater than or equal to 0.01m × 0.01m;

preferably, on two directions perpendicular to each other, said glass body (1) has a size greater than or equal to 0.1m × 0.1m;

preferably, on two directions perpendicular to each other, said glass body (1) has a size greater than or equal to 0.3m × 0.3m;

preferably, on two directions perpendicular to each other, said glass body (1) has a size greater than or equal to 0.5m × 0.5m; and

preferably, on two directions perpendicular to each other, said glass body (1) has a size greater than or equal to 1m × 1m.

15. The vacuum glass according to claim 1, wherein said vacuum glass has a thickness of 1-50mm; and

preferably, said vacuum glass has a thickness of 5-25mm.

16. The vacuum glass according to claim 1, wherein said glass body (1) has a thickness of 1-20mm; and

preferably, said glass body (1) has a thickness of 5-10mm.

17. The vacuum glass according to claim 1, wherein said cavity (5) has a thickness less than 3mm;

preferably, said cavity (5) has a thickness less than 1mm;

preferably, said cavity (5) has a thickness less than 0.5mm;

preferably, said cavity (5) has a thickness less than 0.1mm; and

preferably, said cavity (5) has a thickness less than 0.05mm.

18. The vacuum glass according to claim 1, wherein in at least one direction, said cavity (5) has a size greater than or equal to 0.1m;

preferably, in at least one direction, said cavity (5) has a size greater than or equal to 0.5m; and

preferably, in at least one direction, said cavity (5) has a size greater than or

~~equal to 1m.~~

~~19. The vacuum glass according to claim 1, wherein said cavity (5) has a degree of vacuum less than or equal to 1×10^{-4}Pa;~~

~~preferably, said cavity (5) has a degree of vacuum less than or equal to 1×10^{-3}Pa;~~

~~preferably, said cavity (5) has a degree of vacuum less than or equal to 1×10^{-2}Pa; and~~

~~preferably, said cavity (5) has a degree of vacuum less than or equal to 1×10^{-1}Pa.~~

~~20. A door or a window, comprising the vacuum glass according to any one of claims 1-19.~~

~~21. The door or a window according to claim 20, wherein said door or a window is a door or a window of a building, a door or a window of a structure, a door or a window of a vehicle, a door or a window of a refrigeration equipment, a door or a window of a thermal insulation equipment or a door or a window of a sound insulation equipment.~~

~~22. An instrument or a meter, comprising the vacuum glass according to any one of claims 1-19.~~

~~23. A solar collector, comprising the vacuum glass according to any one of claims 1-19.~~

~~24~~1. A method for preparing a vacuum glass, comprising the following steps:

i) enclosing a cavity with a glass body and a sealant, and disposing a getter in said cavity;

ii) heating ~~the~~ a product of step i) in a vacuum environment, whereby creating a vacuum in said cavity, welding said sealant and said glass body together, and activating said getter;

iii) cooling ~~the~~ a product of step ii), and then obtaining a vacuum glass;

~~preferably, in step i), said getter is passivated getter;~~

~~preferably, in step i), said surface of said getter does not comprise an enclosure, and said enclosure is made of a hermetic material;~~

~~preferably, step i) further comprises disposing a support for supporting said glass body in said cavity;~~

~~preferably, step i) further comprises shaping a sealant into a desired shape in a mold;~~

~~preferably, in step i), the sealant is sealing glass;~~

~~preferably, in step ii), temperature increasing speed is reduced or temperature~~

~~increase is stopped once bubbles start to form in the sealant;~~

~~preferably, in step ii), the heating is performed at a temperature of 300-600 °C;~~

~~preferably, in step ii), the heating is performed at a temperature of 400-500 °C;~~

~~preferably, in step ii), the heating is performed at a temperature greater than or equal to the sealing temperature of the sealant;~~

~~preferably, in step ii), the heating is performed at a temperature greater than or equal to the activation temperature of the getter;~~

~~preferably, in step ii), the heating is performed for a period longer than or equal to the activation time of the getter;~~

~~preferably, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10^{-1}Pa;~~

~~preferably, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10^{-2}Pa;~~

~~preferably, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10^{-3}Pa;~~

~~preferably, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10^{-4}Pa; and~~

~~preferably, said vacuum glass is the vacuum glass according to any one of claims 1-19~~wherein, in step ii), temperature increasing speed is reduced or temperature increase is stopped once bubbles start to form in the sealant.

~~25. The vacuum glass according to claim 1, wherein said support is an elastic gasket.~~

~~26. The vacuum glass according to claim 1, wherein said elastic gasket is made of a metallic material.~~

~~27. The vacuum glass according to claim 1, wherein said getter is disposed at a position close to an inner side of said sealant.~~

~~28~~2. The method according to claim ~~24~~1, wherein step iii) comprises reducing ~~the~~ a degree of vacuum and ~~the~~ a temperature in ~~the~~ a furnace~~,~~ by reducing the pressure in the furnace to atmospheric pressure when the sealant is still in a semi-solid state, subsequently lowering the temperature in the furnace to a solidification temperature of the sealant, and then opening the furnace to obtain the product.

~~29~~3. The method according to claim ~~24~~1, wherein step iii) comprises reducing ~~the~~ a degree of vacuum and ~~the~~ a temperature in ~~the~~ a furnace, by reducing the pressure in the furnace to the atmospheric pressure within 5 to 10 minutes, lowering

the temperature of the furnace to 50 °C or less within 10 to 12 hours, and opening the furnace to obtain the ~~product~~vacuum glass.

~~3~~04. The method according to claim ~~2~~41, wherein step ii) comprises reducing temperature increasing speed or stopping temperature increase in an initial bubble-forming stage.

~~3~~15. The method according to claim 1, characterized in one or more of the following:

wherein, in step i), said getter is passivated getter;

wherein, in step i), said surface of said getter is free of an enclosure, and said enclosure is made of a hermetic material;

wherein, step i) further comprises disposing a support for supporting said glass body in said cavity;

wherein, step i) further comprises shaping the sealant into a desired shape in a mold;

wherein, in step i), the sealant is sealing glass;

wherein, in step ii), the heating is performed at a temperature of 300-600 °C;

wherein, in step ii), the heating is performed at a temperature of 400-500 °C;

wherein, in step ii), the heating is performed at a temperature greater than or equal to the sealing temperature of the sealant;

wherein, in step ii), the heating is performed at a temperature greater than or equal to the activation temperature of the getter;

wherein, in step ii), the heating is performed for a period longer than or equal to the activation time of the getter;

wherein, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10-1Pa;

wherein, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10-2Pa;

wherein, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10-3Pa;

wherein, in step ii), the vacuum environment has an absolute pressure value less than or equal to 1×10-4Pa;

wherein, in step ii), heating is stopped at an initial bubble-forming stage of the sealant~~A greenhouse, wherein an outer wall of said greenhouse comprises the vacuum glass according to any one of claims 1-19~~.

~~326~~. The method according to claim 1, wherein the vacuum glass comprising:

the glass body (1), the cavity (5) enclosed by said glass body (1) and the sealant (4) together, and the getter (3) disposed in said cavity (5);

said cavity (5) is hermetic therein;

the getter (3) is a non-evaporable getter, and said vacuum glass is free of an enclosure for enclosing the getter (3), and said enclosure is made of a hermetic material;

in a direction passing through said cavity (5), said vacuum glass has a thermal conductivity value K less than or equal to 4 W/(m^2·K)~~A solar cell, comprising a photovoltaic conversion component and the vacuum glass according to any one of claims 1-19, wherein said vacuum glass covers said photovoltaic conversion component~~.

7. The method according to claim 6, characterized in one or more of the following,

wherein, said vacuum glass is free of a sealed evacuation port;

wherein, said glass body (1) is free of a sealed evacuation port thereon;

wherein, said sealant (4) is free of a sealed evacuation port thereon;

wherein, said vacuum glass is free of a sealing device for sealing the evacuation port;

wherein, said vacuum glass comprises at least two glass bodies (1);

wherein, said vacuum glass comprises at least three glass bodies (1); and

wherein, adjacent glass bodies (1) are bonded by the sealant (4).

8. The method according to claim 6, wherein said glass body (1) comprises a plate-like glass body;

wherein, said glass body (1) comprises at least two plate-like glass bodies;

wherein, said plate-like glass bodies face each other;

wherein, said plate-like glass bodies are parallel to each other.

9. The method according to claim 6, characterized in one or more of the following,

wherein, said glass body (1) comprises a glass tube;

wherein, said glass body (1) comprises a glass plate;

wherein, said glass plate is a planar glass plate or a curved glass plate.

10. The method according to claim 6, characterized in one or more of the following,

wherein, a plated film or a paste film is provided on at least one glass body (1);

wherein, said glass body (1) has a flat surface;

wherein, said glass body (1) is grooveless;

wherein, said glass body (1) is formed of silicate glass;

wherein, said glass body (1) has a softening point higher than 550 °C;

wherein, said glass body (1) has a softening point higher than 650 °C;

wherein, said glass body (1) has a softening point higher than 750 °C;

wherein, said cavity (5) is a plate-like cavity;

wherein, said vacuum glass comprises at least one cavity (5);

wherein, said vacuum glass comprises at least two cavities (5); and

wherein, the sealant (4) and the glass body (1) are welded together.

11. The method according to claim 6, wherein said sealant (4) comprises sealing glass; characterized in one or more of the following,

wherein, the sealing glass comprises a glass selected from PbO-ZnO-B_2O_3 system, Bi_2O_3-B_2O_3-SiO_2 system, Bi_2O_3-B_2O_3-ZnO system, Na_2O-Al_2O_3-B_2O_3 system, SnO-ZnO-P_2O_5 system, V_2O_5-P_2O_5-Sb_2O_3 system, ZnO-B_2O_3-SiO_2 system and ZnO-B_2O_3-BaO system;

wherein, the sealing glass has a sealing temperature less than 500 °C;

wherein, the sealing glass has a sealing temperature of 300-450 °C; and

wherein, the sealing glass has a sealing temperature of 400-450 °C.

12. The method according to claim 6, characterized in one or more of the following,

wherein, said getter (3) is an activated getter;

wherein, said getter (3) is capable of absorbing one or more gases selected from O_2, N_2, CO_2, CO and H_2;

wherein, said getter (3) comprises an elementary substance with gettering ability, an alloy with gettering ability, a compound with gettering ability or a mixture with gettering ability;

wherein, said getter (3) contains zirconium element or titanium element;

wherein, said getter (3) contains one or more transition metal elements;

wherein, said getter (3) contains one or more rare earth metal elements;

wherein, said getter (3) is a Zr-Al type getter or a Zr-V-Fe type getter;

wherein, said getter (3) is in said cavity (5) in a density of 0.1g/cm^3 or more;

wherein, said getter (3) is in said cavity (5) in a density of 0.5g/cm^3 or more;

wherein, said getter (3) is in said cavity (5) in a density of 1g/cm^3 or more;

wherein, said getter (3) has an activation temperature less than or equal to the sealing temperature of the sealant (4);

wherein, said getter (3) is activated at 300-450 °C;

wherein, said getter (3) is activated by vacuum thermal treatment at 300 °C or more for 1 hour or more, or

said getter (3) is activated by heat treatment in vacuum at 350 °C or more for more than 0.5 hours, or

said getter (3) is activated by heat treatment in vacuum at 400 °C or more for 10 minutes or more.

13. The method according to claim 6, wherein said vacuum glass further comprises a support (2) for supporting said glass body (1) so as to maintain the shape of the cavity (5); characterized in one or more of the following,

wherein, said support (2) is disposed in said cavity (5);

wherein, said support (2) is made of a metallic material or a non-metallic material;

wherein, said support (2) is made of a transparent inorganic substance;

wherein, said support (2) is made of glass;

wherein, said support (2) is a glass sheet;

wherein, said support (2) is a circular glass sheet, an elliptical glass sheet or a polygonal glass sheet;

wherein, said getter is disposed at a position close to an inner side of said sealant;

wherein said support is an elastic gasket;

wherein said elastic gasket is made of a metallic material.

14. A vacuum glass prepared by the method according to any one of claims 1-13.

15. A door, a window, an instrument, a meter or a solar collector, a greenhouse or a solar cell, comprising the vacuum glass according to claim 14;

wherein an outer wall of said greenhouse comprises the vacuum glass;

wherein said vacuum glass covers a photovoltaic conversion component of the solar cell.