What is claimed is:

1. A bulk acoustic wave resonator, comprising a substrate, a transducer stacking structure, and a protective layer, wherein the transducer stacking structure is located on one side of the substrate;

a cavity is arranged in the substrate, and the cavity penetrates through a portion of the substrate;

a release channel is arranged in the transducer stacking structure, and the release channel penetrates through the transducer stacking structure and is communicated to the cavity;

the protective layer is arranged on a surface of one side of the transducer stacking structure away from the substrate; and the protective layer comprises a waterproof material;

wherein the protective layer is further arranged on an inner wall of the release channel and an inner wall of the cavity.

2. The bulk acoustic wave resonator as claimed in claim 1, wherein the bulk acoustic wave resonator further comprises a passivation layer;

the passivation layer is located between the protective layer and the transducer stacking structure, and the passivation layer covers the transducer stacking structure; and

a density of the protective layer is greater than a density of the passivation layer.

3. The bulk acoustic wave resonator as claimed in claim 1, wherein the protective layer comprises one or more of an inorganic oxide material, a metal oxide material, and a nitride material.

4. The bulk acoustic wave resonator as claimed in claim 1, wherein the transducer stacking structure comprises a bottom electrode layer, a piezoelectric layer, and a top electrode layer which are stacked;

the bulk acoustic wave resonator further comprises a first electrode plate and a second electrode plate;

the first electrode plate is connected to the piezoelectric layer and the bottom electrode layer through the protective layer; and the second electrode plate is connected to the top electrode layer through the protective layer.

5. The bulk acoustic wave resonator as claimed in claim 1, wherein the substrate comprises a bottom-layer substrate, a middle insulation layer, and a top-layer substrate; the top-layer substrate is located on one side close to the transducer stacking structure;

the cavity penetrates through the top-layer substrate;

the bulk acoustic wave resonator further comprises a protective wall;

the protective wall covers a side wall of the cavity; and the protective wall is located between the protective layer and the side wall of the cavity.

6. The bulk acoustic wave resonator as claimed in claim 1, wherein the bulk acoustic wave resonator further comprises a seed layer;

the seed layer is located between the substrate and transducer stacking structure; and the seed layer covers the substrate.

7. A preparation method of a bulk acoustic wave resonator according to any one of claims 1 to 6, comprising:

providing a substrate;

growing a transducer stacking structure on one side of the substrate;

etching the transducer stacking structure to form a release channel, and introducing corrosive gas into the release channel to corrode the substrate and to form a cavity in the substrate; and

depositing a layer of protective layer on one side of the transducer stacking structure away from the substrate, so that the protective layer is arranged on a surface of the side of the transducer stacking structure away from the substrate,

wherein the protective layer comprises a waterproof material.

8. The preparation method as claimed in claim 7, wherein depositing the layer of protective layer on the one side of the transducer stacking structure away from the substrate comprises:

depositing the layer of protective layer on the side of the transducer stacking structure away from the substrate by using an atomic layer deposition technology.

9. The preparation method as claimed in claim 7, wherein growing the transducer stacking structure on the one side of the substrate comprises:

growing a bottom electrode layer and a piezoelectric layer in sequence on the one side of the substrate, and patterning the piezoelectric layer to form a groove that penetrates through the piezoelectric layer;

growing a top electrode layer on one side of the piezoelectric layer away from the substrate; and

growing an electrode plate layer on one side of the top electrode layer away from the substrate, and patterning the electrode plate layer to form a first electrode plate and a second electrode plate.

10. The preparation method as claimed in claim 9, wherein providing the substrate comprises:

etching the substrate in advance to form a third groove, wherein a range of the third groove is a range of the cavity; and

growing a sacrificial layer on one side of the substrate close to the third groove, and grinding the sacrificial layer to expose a surface of the substrate, so that the sacrificial layer only fills the third groove.

11. The preparation method as claimed in claim 10, wherein growing the bottom electrode layer and the piezoelectric layer in sequence on the one side of the substrate comprises:

growing a seed layer on one side of the substrate close to the sacrificial layer; and

growing the bottom electrode layer and the piezoelectric layer in sequence on one side of the seed layer away from the substrate.

12. The preparation method as claimed in claim 9, wherein growing the electrode plate layer on the one side of the top electrode layer away from the substrate comprises:

growing a passivation layer on one side of the top electrode layer away from the substrate, and patterning the passivation layer; and

growing the electrode plate layer on one side of the passivation layer away from the substrate.

13. The preparation method as claimed in claim 9, further comprising:

etching one side of the substrate to form a positioning groove, wherein a region surrounded by the positioning groove is a range of the cavity; and

growing a protective wall in the positioning groove, and grinding the protective wall to expose a surface of the substrate, so that the protective wall fills the positioning groove.

14. The preparation method as claimed in claim 13, wherein growing the bottom electrode layer and the piezoelectric layer in sequence on the one side of the substrate comprises:

growing a seed layer on one side of the substrate close to the protective wall; and

growing the bottom electrode layer and the piezoelectric layer in sequence on one side of the seed layer away from the substrate.

15. The preparation method as claimed in claim 7, wherein the substrate comprises a bottom-layer substrate, a middle insulation layer, and a top-layer substrate which are stacked in sequence; the bottom-layer substrate is a silicon layer; and the top-layer substrate is a silicon nitride layer.

16. A bulk acoustic wave filter, comprising an input port, an output port, and a plurality of bulk acoustic wave resonators, wherein at least one of the bulk acoustic wave resonators is the bulk acoustic wave resonator as claimed in claim 1.