CLAIMS

What is claimed is:

1. A staircase structure, comprising:

a plurality of conductive layers spaced apart along a first direction, wherein each of the plurality of conductive layers comprises at least two sub-conductive layers spaced apart along a second direction, and each of the plurality of conductive layers extends along a third direction, the first direction, the second direction, and the third direction intersecting with each other;

a plurality of step structures spaced apart along the second direction, a column of the sub-conductive layers spaced apart along the first direction being in contact connection with at least one of the plurality of step structures;

wherein each of the plurality of step structures comprises a plurality of conductive pillars electrically insulated from each other, each one of the plurality of conductive pillars is in contact connection with a corresponding one of the sub-conductive layers, and each conductive pillar in contact connection with a corresponding sub-conductive layer is electrically insulated from other sub-conductive layers; and in a column of the conductive layers spaced apart along the first direction, the conductive layers are in contact connection with the conductive pillars in a one-to-one manner.

2. The staircase structure according to claim 1, wherein each of the plurality of conductive pillars comprises a main body part and an epitaxial part; the main body part extends along the first direction, and the epitaxial part is located on a side wall, extending along the first direction, of a first portion of the main body part; the epitaxial part is in contact connection with the corresponding sub-conductive layer, and the epitaxial part and the corresponding sub-conductive layer that are in contact connection are in a same layer; and

a plurality of the main body parts in a same step structure are spaced apart along the third direction, and a plurality of the epitaxial parts in the same step structure are located in different layers, respectively.

3. The staircase structure according to claim 2, wherein each conductive pillar further comprises at least one extension part; the extension part is located on the side wall, extending along the first direction, of a second portion of the main body part, and the at least one extension part and the epitaxial part that are in contact connection with a same conductive pillar are spaced apart along the first direction, the extension part and the sub-conductive layers being electrically insulated from each other.

4. The staircase structure according to claim 3, wherein in the at least one extension part in contact connection with a same conductive pillar, each one of the at least one extension part and a corresponding one of the sub-conductive layers are at a same layer; or the at least one extension part in contact connection with the same conductive pillar is located on one side of the epitaxial part along the first direction.

5. The staircase structure according to claim 3, wherein the second direction and the third direction jointly form a reference plane, and an orthographic projection area of the at least one of the extension part on the reference plane is smaller than an orthographic projection area of the epitaxial part on the reference plane.

6. The staircase structure according to claim 2, wherein the main body part is provided with a first surface and a second surface opposite to each other in the first direction, and in the same step structure, along the third direction, distances between different epitaxial parts and the first surface in the first direction progressively increase or progressively decrease.

7. The staircase structure according to claim 1, wherein a column of the sub-conductive layers spaced apart along the first direction is in contact connection with a corresponding one of the step structures, and two of the sub-conductive layers adjacent along the second direction serve as a first sub-conductive layer and a second sub-conductive layer, respectively;

wherein a first step structure in contact connection with the first sub-conductive layer is located on one side, distal to the second sub-conductive layer, of the first sub-conductive layer along the second direction, or the first step structure in contact connection with the first sub-conductive layer is located between the first sub-conductive layer and the second sub-conductive layer; and

a second step structure in contact connection with the second sub-conductive layer is located on one side, distal to the first sub-conductive layer, of the second sub-conductive layer along the second direction, or the second step structure in contact connection with the second sub-conductive layer is located between the second sub-conductive layer and the first sub-conductive layer.

8. The staircase structure according to claim 1, wherein one column of the sub-conductive layers spaced apart along the first direction is in contact connection with two of the step structures, and the two step structures in contact connection with the same one column of the sub-conductive layers are located on two opposite sides of the column of the sub-conductive layers in the second direction, respectively.

9. The staircase structure according to claim 1, wherein spacings between the plurality of conductive pillars and the plurality of conductive layers in each of the step structures are

equal in the second direction.

10. A semiconductor structure, comprising:

the staircase structure according to claim 1; and

a plurality of signal transmission layers spaced apart along the first direction, the plurality of signal transmission layers being in contact connection with the conductive layers in a one-to-one manner, and the sub-conductive layers in a same conductive layer being all in contact connection with a same signal transmission layer;

wherein each of the plurality of signal transmission layers comprises a word line or a bit line.

11. A method for manufacturing a staircase structure, comprising:

forming a plurality of conductive layers spaced apart along a first direction, wherein each of the plurality of conductive layers comprises at least two sub-conductive layers spaced apart along a second direction, and each of the plurality of conductive layers extends along a third direction, the first direction, the second direction, and the third direction intersecting with each other; and

forming a plurality of step structures spaced apart along the second direction, a column of the sub-conductive layers spaced apart along the first direction being in contact connection with at least one of the plurality of step structures;

wherein each of the plurality of step structures comprises a plurality of conductive pillars electrically insulated from each other, each one of the plurality of conductive pillars is in contact connection with a corresponding one of the sub-conductive layers, and each conductive pillar in contact connection with a corresponding sub-conductive layer is electrically insulated from other sub-conductive layers; and in a column of the conductive layers spaced apart along the first direction, the conductive layers are in contact connection with the conductive pillars in a one-to-one manner.

12. The method according to claim 11, wherein steps of forming the conductive layers comprise:

forming a stack structure, wherein the stack structure comprises first dielectric layers and second dielectric layers alternately stacked along the first direction;

performing a first patterning process on the stack structure to form a trench penetrating through the stack structure;

laterally etching the second dielectric layers exposed by the trench to form grooves between adjacent first dielectric layers, with each side of the trench in the second direction being in communication with one of the grooves;

forming one of the sub-conductive layers in one of the grooves; and

forming a third dielectric layer in the trench, wherein a plurality of the sub-conductive layers in contact connection with a same third dielectric layer form one of the conductive layers.

13. The method according to claim 12, wherein steps of forming the step structures comprise:

performing a second patterning process on the stack structure to form a plurality of through holes penetrating through the stack structure and spaced apart along the third direction, wherein the plurality of through holes spaced apart along the third direction constitute one through hole group, and a column of the sub-conductive layers spaced apart along the first direction corresponds to at least one through hole group;

forming a first sacrificial layer in the through holes, wherein in a plurality of the through holes corresponding to a same one column of the conductive layers spaced apart along the first direction, the first sacrificial layer located in the different through holes has different thicknesses in the first direction, and the first sacrificial layer with a smallest thickness is in contact connection with one layer of the first dielectric layers and one layer of the second dielectric layers;

forming a fourth dielectric layer conformally covering remaining side walls of the through holes;

removing the first sacrificial layer in contact connection with one layer of the second dielectric layers by using the fourth dielectric layer as a protective layer, wherein remaining through holes not filled by the first sacrificial layer serve as sub-through holes, so that each of the sub-through holes exposes one layer of the second dielectric layers;

laterally etching the second dielectric layers exposed by the sub-through holes to form epitaxial grooves between adjacent first dielectric layers, wherein the epitaxial grooves expose the sub-conductive layers, and the epitaxial grooves are in communication with the sub-through holes; and

removing a remaining first sacrificial layer, and forming the conductive pillars in the through holes and the epitaxial grooves, wherein a plurality of the conductive pillars formed in a same through hole group constitute one of the step structures.

14. The method according to claim 13, wherein before forming the fourth dielectric layer and after forming the first sacrificial layer, the method further comprises:

laterally etching the second dielectric layers exposed by the through holes to form extension grooves between adjacent first dielectric layers, wherein the extension grooves

expose remaining second dielectric layers, and the extension grooves are in communication with the through holes;

a step of forming the fourth dielectric layer further comprises: forming the fourth dielectric layer conformally covering surfaces of the extension grooves; and

a step of forming the conductive pillars comprises: forming the conductive pillars in the extension grooves.

15. The method according to claim 13, wherein one layer of the first dielectric layers and one layer of the second dielectric layers adjacent to each other along the first direction constitute one sub-stack structure, and in the plurality of through holes corresponding to the same one column of the conductive layers spaced apart along the first direction, a number of sub-stack structures, which are in contact connection with the first sacrificial layer located in the different through holes, varies.

16. The method according to claim 13, wherein in at least two through hole groups corresponding to one column of the conductive layers spaced apart along the first direction, any one of the at least two through hole groups is located on one of two opposite sides of the conductive layer in the second direction, or any one of the at least two through hole groups is located between adjacent sub-conductive layers.

17. The method according to any one of claim 12, wherein a material of the first dielectric layers is silicon oxide, and a material of the second dielectric layers is silicon nitride.

18. The method according to claim 13, wherein a material of the first sacrificial layer is a spin-on dielectric layer.