CLAIMS

1. A method comprising:

patterning, on a first superconducting layer deposited on a first surface of a substrate, a first component of a resonator;

patterning, on a second superconducting layer deposited on a second surface of the substrate, a second component of the resonator, wherein the first surface and the second surface are disposed relative to each other in a non-co-planar disposition;

creating, in the substrate, a recess, the recess extending from the first superconducting layer to the second superconducting layer;

depositing, on an inner surface of the recess, a third superconducting layer, the third superconducting layer forming a superconducting path between the first superconducting layer and the second superconducting layer;

removing, from the first surface and the second surface, forming a completed through-silicon via (TSV), excess material of the third superconducting layer.

2. The method of claim 1, further comprising: depositing, on the patterned first surface, a first protective layer; depositing on the patterned second surface, a second protective layer; and performing the creating such that the recess extends from the first protective layer to the second protective layer.

3. The method of claim 2, wherein the first protective layer comprises an oxide layer.

4. The method of claim 2, further comprising: etching, within a substrate portion of the recess, an undercut region, wherein a diameter of the undercut region is greater than a diameter of the recess at the first superconducting layer.

5. The method of claim 4, wherein the etching is performed using an isotropic silicon dry etch process.

6. The method of claim 4, further comprising: depositing, on the second protective layer prior to creating the recess, an etch stop layer; and removing, from the second protective layer after etching the undercut region, the etch stop layer.

7. The method of claim 6, wherein the etch stop layer comprises a silicon nitride layer.

8. The method of claim 2, further comprising: further depositing the third superconducting layer on the first protective layer and the second protective layer.

9. The method of claim 8, further comprising: further removing the third superconducting layer from the first protective layer and the second protective layer.

10. The method of claim 2, further comprising: further removing, from the first patterned surface and the second patterned surface, the first protective layer and the second protective layer.

11. The method of claim 10, further comprising: etching, prior to removing the first protective layer and the second protective layer, a portion of the third superconducting layer, the portion occupying the recess in the protective layer.

12. The method of claim 1, wherein each of the first superconducting layer, the second superconducting layer, and the third superconducting layer, comprises a titanium nitride layer.

13. The method of claim 1, wherein the removing uses an etching process.

14. The method of claim 1, wherein the completed TSV is a hollow superconductor.

15. The method of claim 1, wherein the first component of the resonator is an inductive element, and wherein the inductive element and a qubit are disposed on the same surface.

16. The method of claim 1, wherein the first component of the resonator is a capacitive element, and wherein the capacitive element and a qubit are disposed on the same surface.

17. The method of claim 1, wherein the first component of the resonator is a conductive pad, wherein the conductive pad and a qubit are disposed on the same surface, and wherein an inductive element and a capacitive element of the resonator are disposed on the opposite surface.