CLAIMS

1. A method, comprising:

depositing an adhesion layer onto a superconducting resonator and a silicon substrate that are comprised within a quantum processor, wherein the superconducting resonator is positioned on the silicon substrate, and wherein the adhesion layer comprises a chemical compound having a thiol functional group.

2. The method according to the preceding claim, wherein the adhesion layer comprises at least one organic thiol chemical compound selected from the group consisting of 4-mercaptobenzoic acid, 4-aminothiophenol, and glycidopropanethiol.

3. The method according to any of the preceding claims, wherein the adhesion layer is a self-assembled monolayer of an organic thiol chemical compound.

4. The method according to any of the preceding claims, further comprising, prior to depositing the adhesion layer:

removing a first oxide layer from the silicon substrate via an etching process; and

removing a second oxide layer from the superconducting resonator via a process selected from the group consisting of an annealing process and the etching process.

5. The method according to the preceding claim, wherein a qubit is further positioned on the silicon substrate and coupled to the superconducting resonator, and wherein the method further comprises removing a third oxide layer from the qubit via the etching process.

6. The method according to any of the preceding claims, further comprising:

depositing a metal fluoride layer onto the adhesion layer to encapsulate the superconducting resonator, wherein the metal fluoride layer comprises at least one member selected from the group consisting of calcium fluoride, lithium fluoride, manganese fluoride, iron fluoride, cobalt fluoride, nickel fluoride, and copper fluoride.

7. The method according to the preceding claim, wherein the depositing comprises depositing the metal fluoride layer onto the adhesion layer via thermal evaporation.

8. A method, comprising:

depositing a chemical compound having a thiol functional group onto a surface of a silicon substrate and a surface of a superconducting resonator, wherein the surface of the silicon substrate and the surface of the superconducting resonator are oxide-free.

9. The method according to the preceding claim, wherein the chemical compound is comprised within an adhesion layer that promotes adhesion between a metal fluoride coating and at least one surface selected from the group consisting of the surface of the silicon substrate and the surface of the superconducting resonator.

10. The method according to any of the preceding claims 9 to 10, further comprising, prior to depositing the chemical compound:

removing a first oxide layer from the surface of the silicon substrate via an etching process; and

removing a second oxide layer from the surface of the superconducting resonator via at least one process selected from the group consisting of an annealing process and the etching process.

11. The method according to any of the preceding claims 8 to 10, further comprising:

encapsulating the superconducting resonator with a metal fluoride coating, wherein the metal fluoride coating comprises at least one member selected from the group consisting of calcium fluoride, lithium fluoride, manganese fluoride, iron fluoride, cobalt fluoride, nickel fluoride, and copper fluoride.

12. A method, comprising:

preparing a surface of a quantum processor for adhesion with a metal fluoride coating by depositing a chemical compound having a thiol functional group onto a silicon substrate and a superconducting resonator of the quantum processor.

13. The method according to the preceding claim, further comprising, prior to depositing the chemical compound:

removing a first oxide layer from the silicon substrate via an etching process; and

removing a second oxide layer from the superconducting resonator via a process selected from the group consisting of an annealing process and the etching process.

14. The method according to any of the preceding claims 12 to 13, wherein the chemical compound is selected from the group consisting of 4-mercaptobenzoic acid, 4-aminothiophenol, and glycidopropanethiol, and wherein the metal fluoride coating comprises at least one member selected from the group consisting of calcium fluoride, lithium fluoride, manganese fluoride, iron fluoride, cobalt fluoride, nickel fluoride, and copper fluoride.

15. The method according to any of the preceding claims 12 to 14 and with features of claim 13, wherein the preparing further comprises depositing the chemical compound onto a qubit of the quantum processor, and wherein the method further comprises removing a third oxide layer from the qubit via the etching process.

16. An apparatus, comprising:

an adhesion layer positioned on a superconducting resonator that is located on a surface of a silicon substrate, wherein the superconducting resonator and the silicon substrate are comprised within a quantum processor, and wherein the adhesion layer comprises a chemical compound having a thiol functional group.

17. The apparatus according to claim 16, further comprising:

a metal fluoride layer that encapsulates the superconducting resonator, wherein the adhesion layer is between the metal fluoride layer and the superconducting resonator.

18. The apparatus according to the preceding claim, wherein the chemical compound is selected from the group consisting of 4-mercaptobenzoic acid, 4-aminothiophenol, and glycidopropanethiol, and wherein the metal fluoride layer comprises at least one member selected from the group consisting of calcium fluoride, lithium fluoride, manganese fluoride, iron fluoride, cobalt fluoride, nickel fluoride, and copper fluoride.

19. The apparatus according to any of the preceding claims 16 to 18, wherein the adhesion layer coats a surface of the superconducting resonator and the surface of the

silicon substrate, and wherein the surface of the silicon substrate and the surface of the superconducting resonator of the superconducting resonator are oxide-free.

20. An apparatus, comprising:

an adhesion layer positioned between a superconducting resonator and a metal fluoride layer, wherein the superconducting resonator is positioned on a silicon substrate within a quantum processor.

21. The apparatus according to claim 20, wherein the adhesion layer comprises a chemical compound having a thiol functional group.

22. The apparatus according to any of the preceding claims 20 to 21, wherein the chemical compound is selected from the group consisting of 4-mercaptobenzoic acid, 4-aminothiophenol, and glycidopropanethiol, and wherein the metal fluoride layer comprises at least one member selected from the group consisting of calcium fluoride, lithium fluoride, manganese fluoride, iron fluoride, cobalt fluoride, nickel fluoride, and copper fluoride.

23. The apparatus according to any of the preceding claims 20 to 22, wherein the adhesion layer is further positioned between the metal fluoride layer and the silicon substrate.

24. The apparatus according to any of the preceding claims 20 to 23, wherein the metal fluoride layer and the adhesion layer encapsulate the superconducting resonator on the silicon substrate.

25. The apparatus according to any of the preceding claims 20 to 24, wherein a surface of the superconducting resonator that is adjacent to the adhesion layer is oxide-free.