Claims

1. A quantum processing device comprising:

one or more functional nanowires, each functional nanowire connected to at least one of a source and a drain;

a sensing nanowire spaced from the one or more functional nanowires and connected to at least one of a source and a drain;

one or more gate electrodes capacitively coupled with each of the one or more functional nanowires;

one or more electrodes capacitively coupled with the sensing nanowire; and

a floating coupler positioned between and electrostatically coupling the one or more functional nanowires and the sensing nanowire; and

a controller connected to the one or more gates of the sensing nanowire and the one or more gates of the one or more functional nanowires;

wherein during operation, the controller is configured to apply biasing voltage to bias the one or more gates of the sensing nanowire and the gates of the one or more functional nanowires such that a sensing quantum dot is formed in the sensing nanowire and one or more functional quantum dots are formed in the one or more functional nanowires and the sensing quantum dot senses changes in electric charges in each of the one or more functional quantum dots.

2. The quantum processing system of claim 1, wherein the quantum processing system includes one functional nanowire and the functional nanowire includes two gates.

3. The quantum processing system of claim 2, wherein the floating coupler comprises two floating gates.

4. The quantum processing system of any one of claims 1-3, wherein during operation, a potential difference is maintained between the sensing nanowire and the one or more functional nanowires to form one or more functional quantum dots in the one or more functional nanowires under the floating gates.

5. The quantum processing system of any of the claims 1-4, wherein the sensing nanowire includes two gates and the two gates are biased to the same voltage.

6. The quantum processing system of claim 4, wherein to form the functional quantum dots under the floating gates in the functional nanowire, the sensing nanowire and the functional nanowire are biased in voltage relative to each other.

7. The quantum processing system of claim 1, wherein the quantum processing system includes one functional nanowire and the functional nanowire includes multiple gates.

8. The quantum processing system of claim 7, wherein at one end, the floating coupler is coupled with the sensing nanowire and at the other end the floating coupler includes multiple branches, where each branch is coupled with the functional nanowire.

9. The quantum processing system of claim 8, wherein potential difference is maintained between the sensing nanowire and the functional nanowire to form functional quantum dots under one or more of the branch gates of the floating coupler.

10. The quantum processing system of claim 1, wherein the quantum processing system includes multiple functional nanowires and each functional nanowire includes two or more gates.

11. The quantum processing system of claim 10, wherein the floating coupler includes a trunk section, multiple branch sections and each branch section comprises one or more leaf gates, and the end of the trunk section is coupled with the sensing nanowire whereas the leaf gates are coupled with the functional nanowires.

12. The quantum processing system of claim 11, wherein a potential difference is maintained between the sensing nanowire and each of the functional nanowires to form functional quantum dots under one or more of the leaf gates of the floating coupler.

13. A method for controlling operation of a quantum processing system, the quantum processing system comprising one or more functional nanowires, a sensing nanowire spaced from the one or more functional nanowires, one or more gate electrodes capacitively coupled with each of the one or more functional nanowires and one or more electrodes capacitively coupled with the sensing nanowire, a floating coupler positioned between and electrostatically coupling the one or more functional nanowires and the sensing nanowire, and a controller connected to the one or more gates of the sensing nanowire and the one or more gates of the one or more functional nanowires, the method comprising:

at the controller, receiving a current reading from the sensing nanowire;

determining a biasing voltage to be applied to the one or more gates of the sensing nanowire based on the received current reading;

determining a biasing voltage to be applied to the one or more gates of the one or more functional nanowires based on the received current reading;

causing the determined biasing voltage to be applied to the one or more gates of the sensing nanowire; and

causing the determined biasing voltage to be applied to the one or more gates of the one or more functional nanowires;

wherein the biasing voltages are determined such that a sensing quantum dot is formed in the sensing nanowire, one or more functional quantum dots are formed in the one or more functional nanowires and the sensing quantum dot senses charge transition events in each of the one or more functional quantum dots.

14. The method of claim 13, wherein the quantum processing system includes one functional nanowire and the functional nanowire includes two gates and the floating coupler comprises two floating gates.

15. The method of claim 14, further comprising, maintaining a potential difference between the sensing nanowire and the one or more functional nanowires to form one or more functional quantum dots in the one or more functional nanowires under the floating gates.

16. The method of any one of claims 13-15, wherein the sensing nanowire includes two gates and wherein the method comprises determining and causing the same biasing voltage to be applied to the two gates of the sensing nanowire.

17. The method of any one of claims 15-16, further comprising biasing the sensing nanowire and the functional nanowire in voltage relative to each other to form the one or more functional quantum dots in the one or more functional nanowires.

18. The method of claim 13, wherein the quantum processing system includes one functional nanowire and the functional nanowire includes multiple gates and wherein at one end, the floating coupler is coupled with the sensing nanowire and at the other end the floating coupler includes multiple branches, where each branch is coupled with the functional nanowire.

19. The method of claim 18, comprising: biasing the sensing nanowire and the functional nanowire in voltage relative to each other to form functional quantum dots under one or more of the branches of the floating coupler.

20. The method of claim 13, wherein the quantum processing system includes multiple functional nanowires and each functional nanowire includes two or more gates and wherein the floating coupler includes a trunk section, multiple branch sections and each branch section comprises one or more leaf gates, and the end of the trunk section is coupled with the sensing nanowire whereas the leaf gates are coupled with the functional nanowires.

21. The method of claim 20, further comprising the step of biasing each of the functional nanowires in voltage relative to the sensing nanowire to form functional quantum dots under one or more of the leaf gates of the floating coupler.