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研究獎學金

Research Scholarship

Measurement techniques in silicon metal-oxide-semiconductor qubits system

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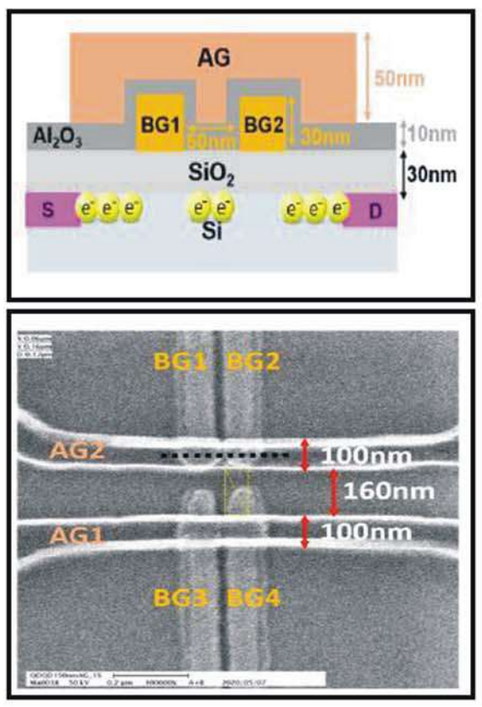
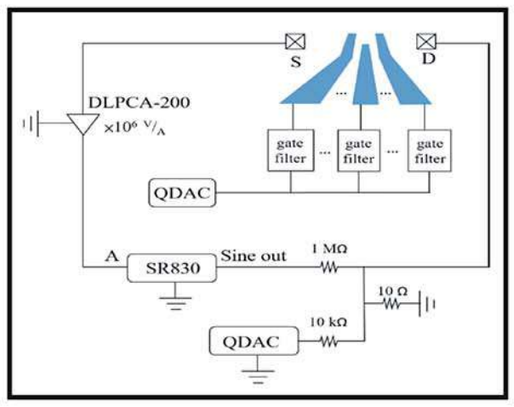
Introduction

In the 1990s, many works began to appear which are theoretical and the experiment challenges about the quantum computers. In order to increase coherence time, the materials can be switched to the group IV semiconductors. For example, spin-free isotopes of carbon[2] and silicon[3] exhibit property of long coherence[4].

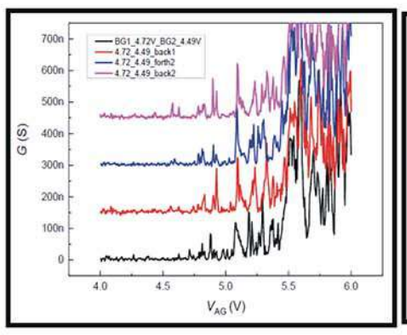
This body of work aims to contribute to the field by performing electron transport measurements and demonstrating a technique for defining quantum dots using tunable barriers in silicon.

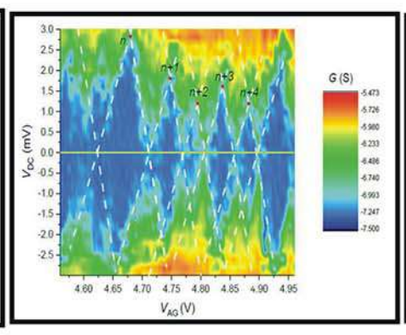
Method

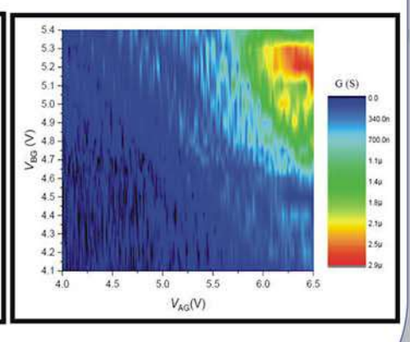




- Looking for the situation where the conduction channel is only barely conducting, $V_{BG} = 4.7$ V was decided.
- The barrier voltages at $V_{BG1} = 4.72$ V and $V_{BG2} = 4.79$ V produced clear peaks repeatedly when sweeping V_{AG}.
- The characteristic Coulomb diamond is produced by applying a source-drain bias to the conductance measurement.







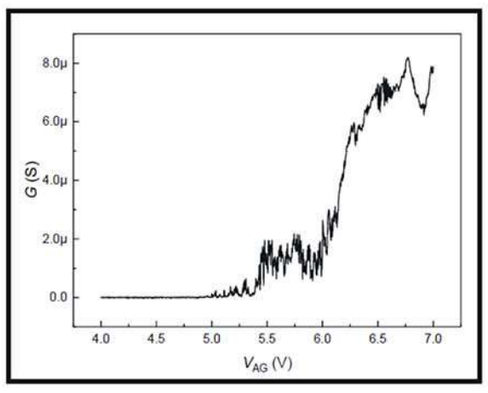
Conclusion

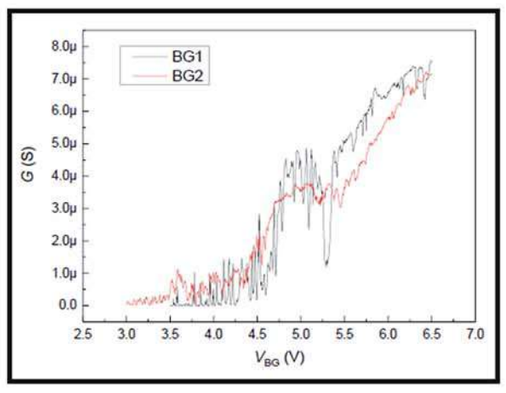
The electron transport properties can be demonstrated in the bi-layer silicon quantum dots :

- The threshold voltage is higher than other materials.
- Coulomb oscillations and Coulomb diamond can be exhibited clearly and reproducibly.
- Future work could look into magnetic field dependence studies. A more extensive investigation on the effects of magnetic field would yield critical information about the spin configuration of electrons.

Results

- The threshold voltage, V_{th}, was found to be 5.4 V for this device.
- Good pinch-off characteristics were recorded in the left figure for both barriers.





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