CNST Center for Nanoscale Science & Technology

Single-Electron Silicon Devices

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GOAL

To fabricate nanoscale silicon metal–oxide–semiconductor field-effect transistors (MOSFETs) that can control the motion of single electrons.

KEY ACCOMPLISHMENTS

Developed an 80-step process to make silicon MOSFETs with doped sources and drains, conducting channels, and two levels of polycrystalline silicon gates.

Demonstrated MOSFET performance that is reliable, homogeneous, and robust.

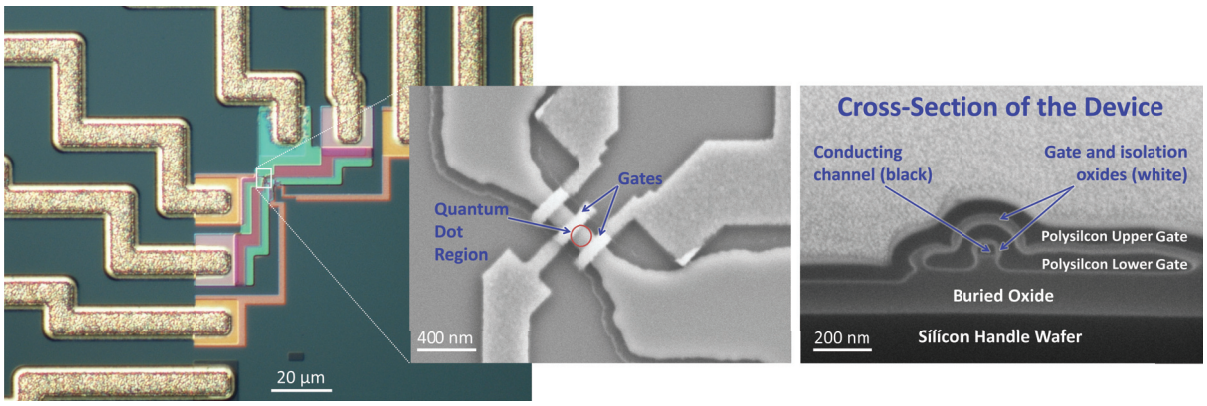
Demonstrated clear single-electron transistor behavior.

KEY NANOFAB PROCESSES

Growth of high-quality gate oxides using a high-purity oxidation furnace.

Integration and alignment of electron beam lithography with dry mesa etching of single crystal and polycrystalline silicon.

Left: *Microscope image of the multi-level silicon metal–oxide–semiconductor field-effect transistor, including gold contacts.*
Middle: *Scanning electron micrograph of a single-electron silicon device. Electrons are trapped in a quantum dot, defined by the field from two conducting gates.*
Right: *Cross-sectional focused ion beam image of the same device, showing a conducting channel, two levels of polysilicon gates, and two levels of oxide.*



REFERENCE

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