HIGH-ACCURACY PUMPING WITH SILICON QUANTUM DOTS

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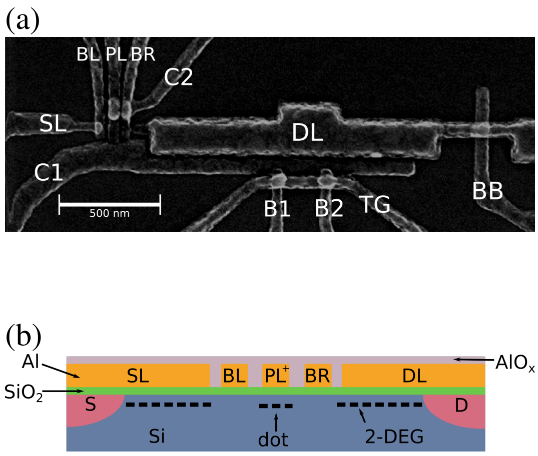
For the future quantum metrological applications a robust and reliable current source is needed. Silicon devices seem promising candidates for providing quantized current for new ampere definition [1]. To create high-accuracy current, the elementary charge has to be transported from source to drain one-by-one, controlled by barrier gates and plunger gates with ac voltages. We present measurement results of a single-electron pump characterization method, which shows the limitations of electron transport [2]. Distinguishing electron nonadiabatic separation and adiabatic lifting from the Fermi sea to a dynamic quantum dot, by synchronously closing the tunable barriers, introduces a new approach of operating quantum-based single-electron devices, and helps to improve pumping accuracy.



(a) Scanning electron micrograph of the single-electron pump. Barrier and plunger (BL, BR, and PL) gates are employed to form a quantum dot. BL and PL used to pump electrons. Drain and Source lead gates (DL and SL) induce the source and drain reservoirs, 2DEG in (b). Big barrier (BB) can be used to create a large reservoir dot. A single-electron transistor (B1, B2, and TG) is employed to detect single charges [3]. Confining gates (C1 and C2) are employed to confine the pump dot.
(b) Schematic cross section of the device.

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