Three-terminal memristive RF switch

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Due to their small size, low power consumption, and excellent radio frequency performance, two-terminal nanoscale memristive radiofrequency switches are a promising candidate for microwave applications [1]. However, as a two-terminal device, it requires multiplexing actuation signals with the RF signals. Here we propose a three-terminal memristive radiofrequency switch, where the gate electrode is separated from current path. By applying a gate voltage, the switch can be reversibly turned on or off when a metallic bridge electrochemically forms or dissolves between the source and drain. The turn-on voltage is 0.95 V while the turn-off voltage is –0.2 V. Devices have been fabricated with ON resistances as low as 12.5 Ω and an ON/OFF current ratios as high as 13,000. When measured up to 67 GHz, the device also demonstrates low insertion loss (0.4 dB at 40 GHz) and high isolation (22 dB at 40 GHz).

Reference:

[1] S. Pi, M. Ghadiri-Sadrabadi, J. C. Bardin, and Q. Xia, “Nanoscale Memristive Radiofrequency Switches.” Nat. Commun., vol. 6, no. 7519, pp. 1–9, June 2015.

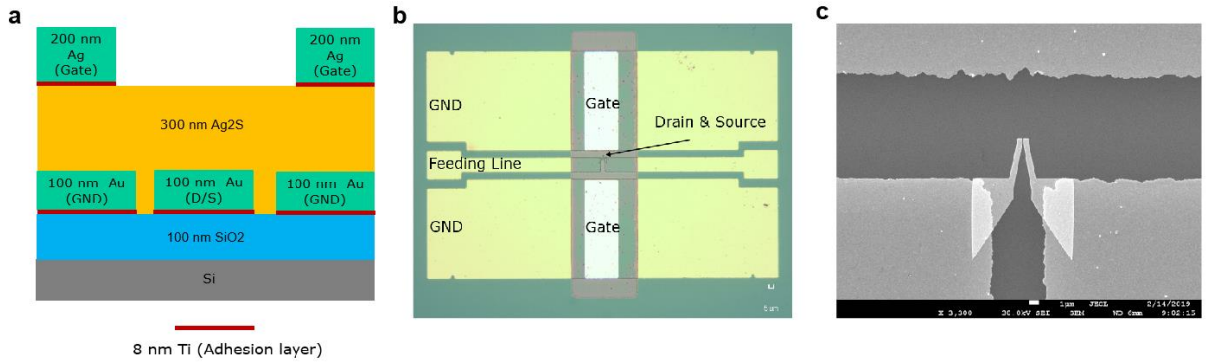

Figure 1. Three-terminal memristive RF switch is a vertical device. Drain and source are placed on the top of silicon dioxide and have a 100 nm gap between each other. Gate is separated with them by 300 nm silver sulfide. (a) Schematic illustration of the geometry for the memristive RF switch. (b) Top-view of the fabricated device. (c) SEM image of the drain and source electrodes.

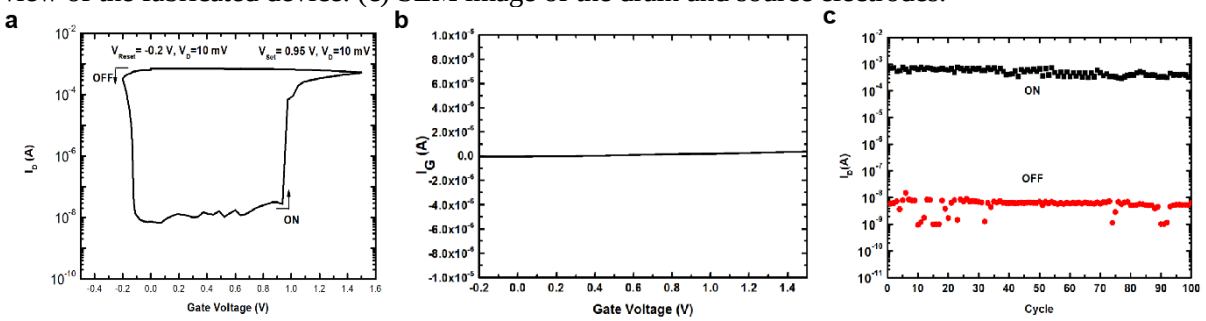

Figure 2. DC performance of the three-terminal memristive RF switch. (a) Turn-off and -on process by applying voltage to gate. (b) I_G with changing V_G. (c) Cycling characteristics of the device.

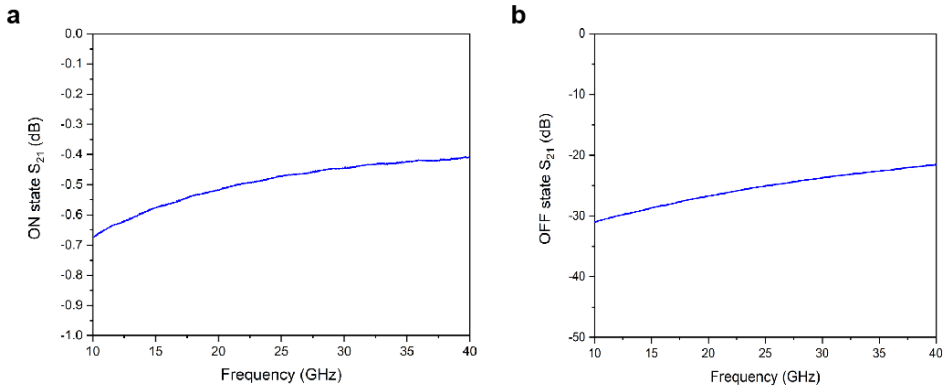

Figure 3. Transmission characterization of the three-terminal memristive RF switch. (a) Transmission spectrum of the device at the ON state. The insertion loss at 40 GHz for this device is 0.4 dB. (b) Transmittance spectrum of the device at the OFF state. The isolation at 40 GHz is 22 dB.

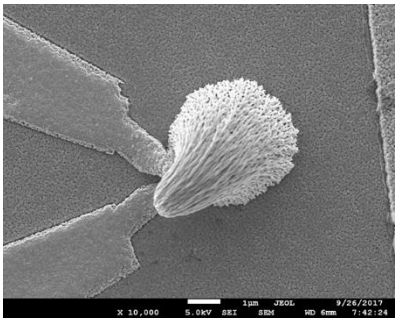

Figure 4. SEM image of the device at the ON state. The three-terminal memristive RF switch is turned on through the formation of a silver filament between the two electrodes.