

Supplementary Information

Nonvolatile resistive memory devices based on Ag

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Experimental

Device Fabrication: All of the materials used in this study were purchased from Aldrich and were used as received without further purification. The substrates were cleaned in solution of detergent and water. Then ultrasonic with deionized water, acetone and isopropanol. After that, the substrate was dried at 120°C for 2h. A 50 nm silver layer was coated on the substrate by vacuum evaporation. To fabricate the Vertical device, the silver layer is about 70nm. The pressure in the chamber was about 1.0×10^{-5} Pa. The above silver film and sulfur powders were put into a petri dish. Then N, N-dimethylformamide (DMF) was added. The container was maintained at 25 °C for different hours, after that a black thin film on the substrate was obtained. This thin film was washed with ethanol for several times, and dried in the vacuum drying oven. Top silver electrode was thermally evaporated on the film through a shadow mask at a pressure around 1.0×10^{-5} Pa. Finally, memory device based silver was obtained.

Characterization: The obtained thin film was characterized by scanning electron microscopy (SEM, Hitachi S-4800N) and the Electrical characterizations were recorded with a Keithley 4200 and a Micromanipulator 6150 probe station at room temperature in air (testing in nitrogen glove box gives no difference in device performance).

The Ag and Ag₂S Film images are shown

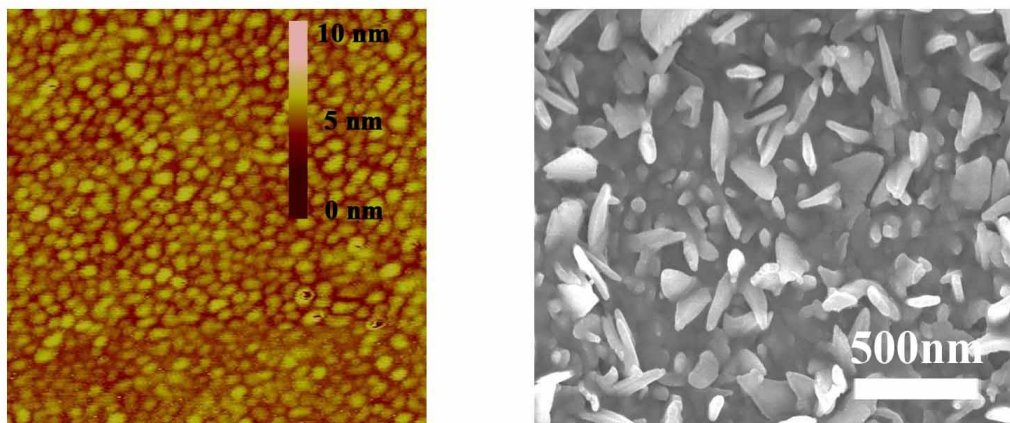


Figure S1. (a) AFM image (500 nm × 500 nm) of 2nm-Ag film. (b) SEM image of Ag₂S/Ag films with S-Ag reaction time of 4h.

The XRD spectra of Ag and Ag₂S Films

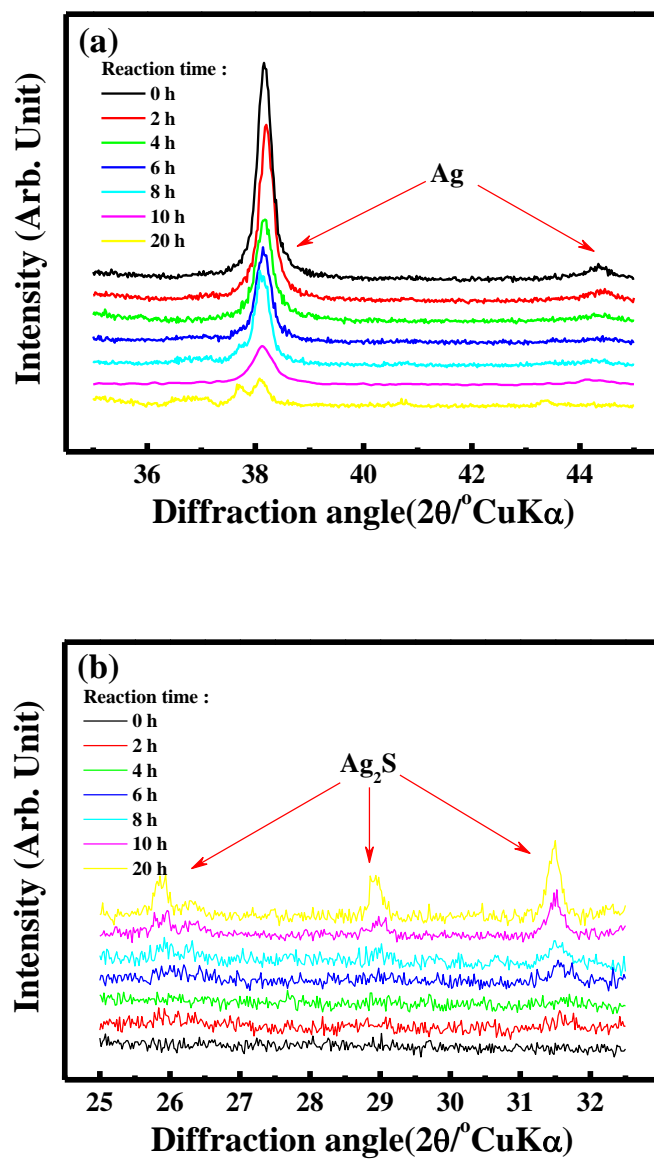
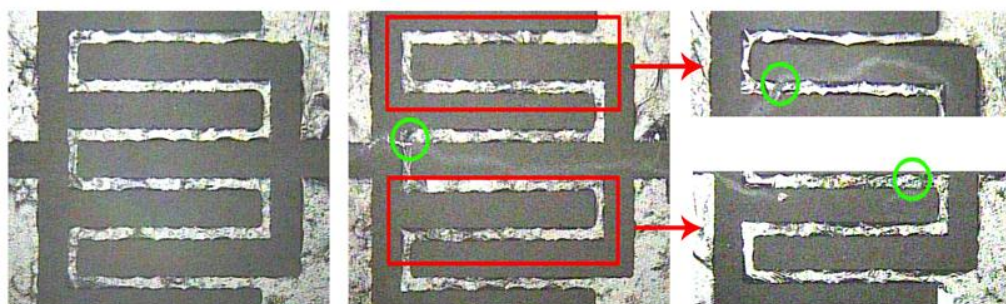


Figure S2. The XRD spectra of Ag₂S/Ag films with various S-Ag reaction times are tested. (a) For Ag peaks. (b) For Ag₂S peaks.



Filament effects

Figure S3. Breaking (cutting) the formed bright line in the $\text{Ag}_2\text{S}/\text{Ag}$ film and perform another voltage sweep (the middle picture), the device repeats its behavior from OFF state to ON state (the right picture): another bright line forms at the critical voltage (bridging up the two electrodes), and the device is turned on (after completely scratching the line away, the device is separated into two devices, as shown in the right picture. We performed test for the two separately and filament form for both, which are marked by blue circles). The left picture is original one without any voltage sweep.