Electronic Supplementary Information

Thermally stable resistive switching of a polyvinyl alcohol-based atomic switch

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Materials and methods

Ag/Ag-PVA/Pt device fabrication: Ti (5 nm) as the adhesion layer and Pt (25 nm) as the bottom electrode (BE) were initially deposited on a Si substrate coated with SiO_2 (300 nm thick), using the electron-beam (EB) evaporation technique. PVA (0.1 g, M_W = 1.3 × 10^5 $gmol^{-1}$, Aldrich) was initially dissolved into distilled water (8 ml) and stirred constantly for 45 min at 90 °C. After being cooled down to room temperature, silver perchlorate (3 wt%, $AgClO_4$, Aldrich) was added into the homogeneous PVA solution. This Ag-PVA reaction mixture was stirred again for 15 min at room temperature. Then, 150 μL of Ag-PVA solution was spin coated onto the BE to form a uniform Ag-PVA film with a thickness of ~100 nm. Finally, Ag (30 nm) as the top electrode (TE) and Pt (30 nm) as a protective layer were EB deposited onto the Ag-PVA film.

Characterizations: All *I–V* measurements were performed on the fabricated Ag/Ag-PVA/Pt device, at atmospheric pressure and at various temperatures ranging from 25 to 70 °C, using a semiconductor characterization system (Keithley 4200-SCS/F) equipped with a temperature controlled two-probe measurement stage. The *I–V* curves were obtained under the application of bias voltage to the Ag TE and swept with a constant sweep rate, while the Pt BE was grounded. DCS and TG analyses were carried out using a HT-Seiko Instrument SII Exter X-DCS7000 and 6300 TG/DTA, respectively. For these measurements, a Ag-PVA film with a thickness of ~160 μm was prepared by the drop-casting method. These data were obtained in a cooling and heating cycle, with a constant cooling/heating rate of 10 °C min^{-1}.

DCS curve of Ag-PVA electrolyte, measured at the second scan

The Ag-PVA electrolyte exhibits a broad endotherm around 125 °C in the DSC curve measured at the first scan, as shown in Fig. 5. When the measurement is repeated immediately after the first scan, this endotherm disppeared and T_g is increased, as shown in Fig. S1. This indicates water evaporation from the Ag-PVA film at elevated temperatures, which in turn reduces the interaction between PVA hydroxyl groups and water molecules.

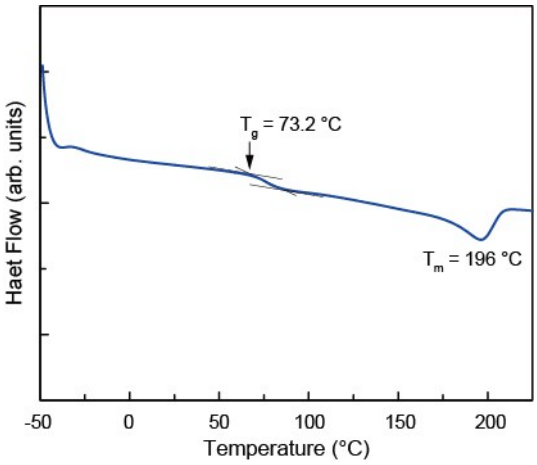

Figure S1. DSC curve of Ag-PVA, measured at the second scan in nitrogen atmosphere.