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Supplementary Information

Non-volatile memristor Based Artificial Synaptic Behavior of Redox-Active Organic Composite

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The FT-IR spectroscopy of 5%, 20%, and 30% TMA in the PVP solution is shown in figure S1(a). The AFM images of the other three devices are shown in figure S1(b)-(d) below. Figure S1 (b) shows the surface morphology for device T2, which has 5% of TMA and 95% of PVP in a 25 mg/ml solution. The RMS roughness of the film is 16.53 nm and the average roughness is 12.96 nm. The roughness of the thin film increases exponentially with an increase in wt% of TMA molecule in the solution. The RMS roughness for T4 and T5 is 19.98 and 21.44 nm.

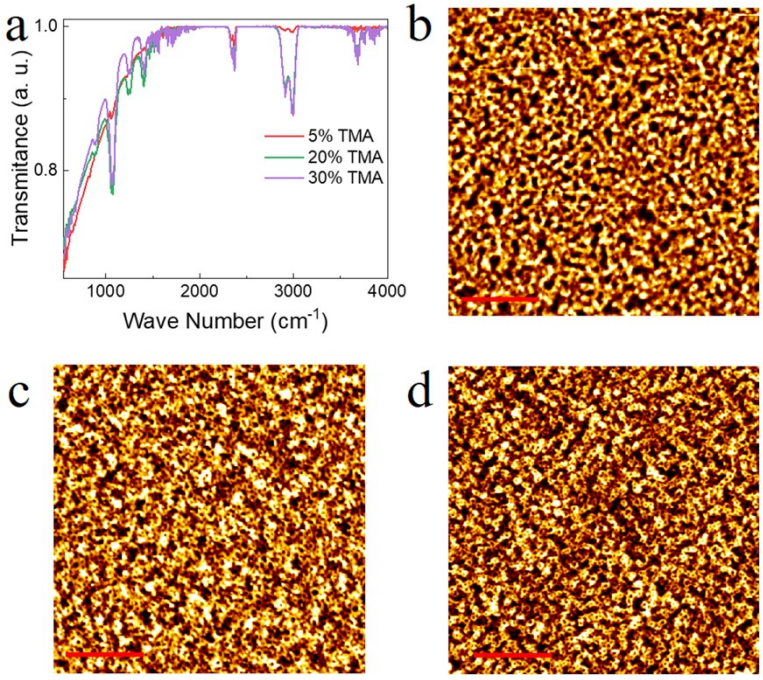

Figure S1: (a) The FT-IR spectroscopy of 5%, 20%, and 30% TMA in PVP solution. The AFM image of the thin films with different molecular wt% (b) The morphology of the thin film with 5 wt% of TMA (c) 20 wt% of TMA (d) 30 wt% of TMA. The red-colored scale bar has a value of 2.5 μm.

The thickness of the devices T2, T4, and T5 are measured using a Kapton tape on the film and measuring its height profile at the edge between the tape and the exposed part. The average height of the films is 173 nm, 162 nm, and 158 nm for the device T2, T4, and T5 respectively and are shown in figures S2(a)-(c). The AFM images of the scanned areas are shown in the insets of figures S2(a)-(c).

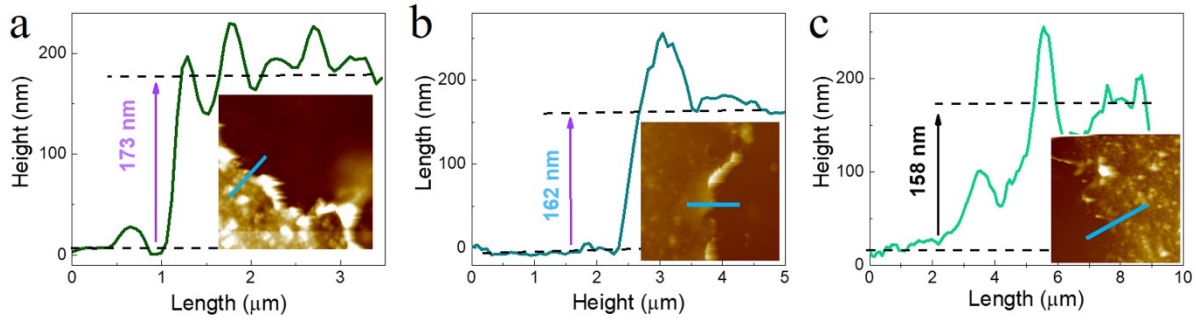

Figure S2: Thickness measurement of the devices (a) T2, (b) T4, and (c) T5. The thickness was measured by AFM and creating a step on the thin film. The inset of the images shows AFM images at the step of the thin film.

The current-voltage characteristics of the devices are shown in figure S3. The device T2 is showing an analog type of switching at a comparatively higher voltage of − 2.75 V. The higher current for the device is in the range of microampere. As the percentage of TMA increases, the switching voltage decreases; for example, the T3 device has a switching voltage of − 2.5 V and the T4 and T5 devices have a switching voltage of − 2.25 V. The switching type has changed from analog to abrupt type when the TMA percentage is increased. The highest current range also changes from microampere to milliampere. The on-off ratio for the devices has a maximum value for the T3 device and decreases for T4 and T5 devices.

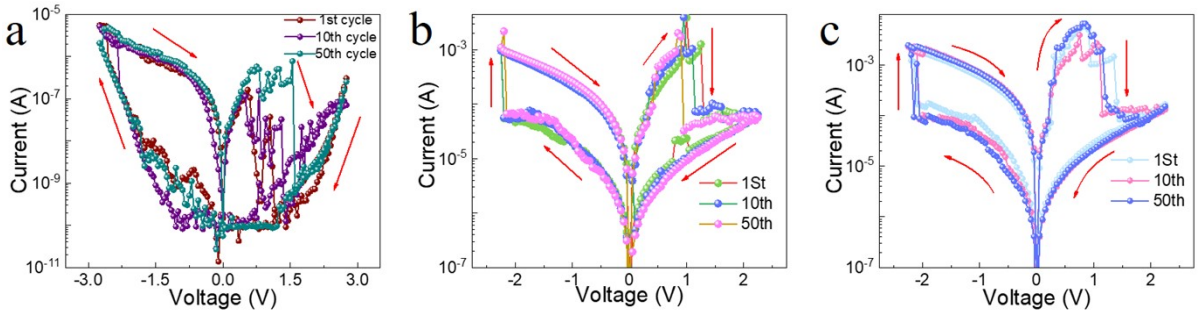

Figure S3: The current-voltage characteristics of the devices for the device (a) T2, (b) T4 and (c) T5. Device T2 has a switching voltage of − 2.75 V, while devices T4 and T5 have a switching voltage of − 2.25 V.

A device of Al/PVP/ITO was fabricated to check whether it shows any switching. The current-voltage characteristics have been shown in figure S4(a). No switching properties of the device can be found that confirm the switching in our device is induced by the TMA molecule. The same I-V characteristic is shown in the semi-logarithmic scale in figure S4(b)

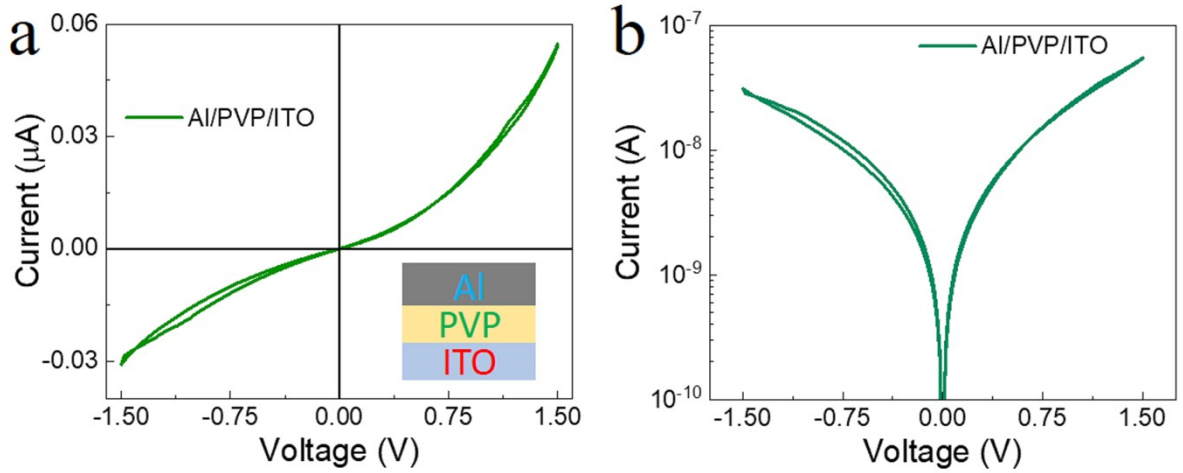

Figure S4: The Current-voltage characteristics of a PVP-based device with ITO and Al as bottom and top contacts. (a) the linear I-V curve shows there are no switching properties for the device. The inset shows the device structure. (b) The semilogarithmic plot of current-voltage characteristics of the device.