

Supporting Information (SI)

Green material thin films for stable electrical switching in a low-cost washable memory Device, A proof of the concept

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S1. Material Characterization

Various techniques such as XRD, XPS, FESEM, AFM, FTIR, PL, and Raman spectroscopy were used to characterize pectin based thin films. The surface morphology and the thickness of pectin thin films were analyzed using Field Emission Scanning Electron Microscope (FESEM) (JEOL, JSM-6480). The surface topography measurements were Atomic Force Microscope (RHK Technology®) operating at ultra-high vacuum (UHV) ($\sim 10^{-11}$ mbar) conditions. The defect chemistry of pectin based thin films by *Philips®/PANalytical Xpert-is* used to find out the crystallographic information of pectin based thin film. The average crystalline size of the was calculated with the help of Scherrer's formula¹.

$$D\beta = \frac{0.89\lambda}{\beta \cos\theta} \dots\dots\dots(1)$$

Whereas λ indicates the incident wavelength of radiation and β shows the full width half maximum (FWHM). The detailed material characterization and test structure is provided in Supporting Information file. Whereas Keithley 4200 source measurement unit (SMU) along with 4th probe station was utilized to

record the resistive switching of fabricated pectin-based memory cell at room temperature / testing temperature (up to 100 C) using convection oven and humidity (45 %).

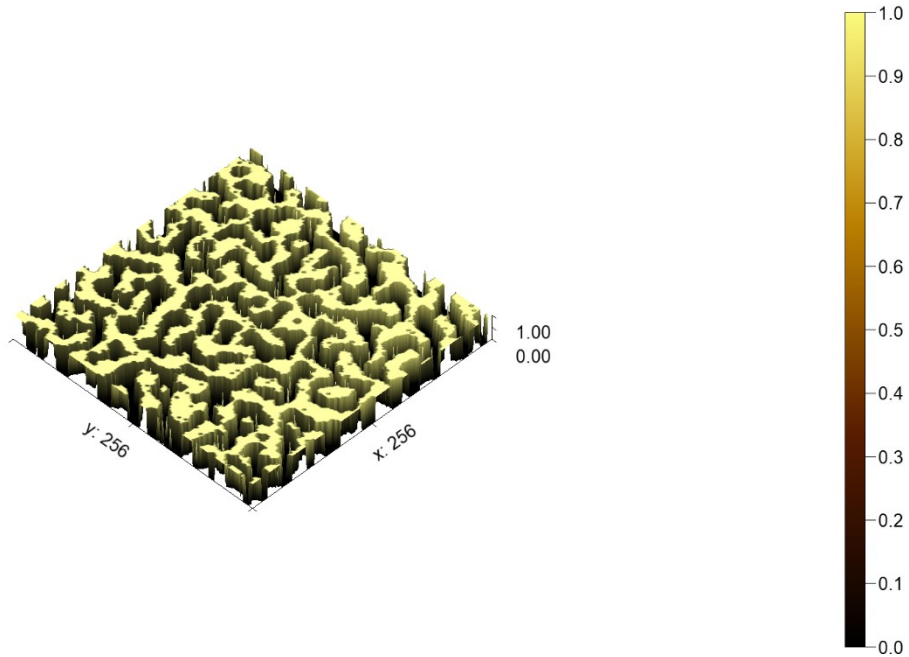


Figure S1. Phase topography of pectin thin films.

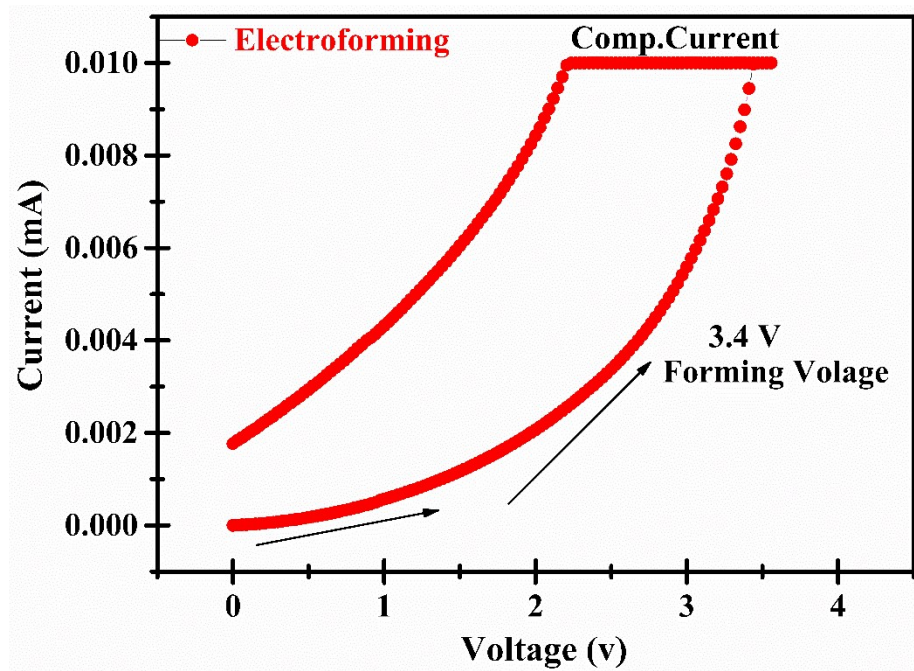


Figure 2. Represents the electroforming phenomena in pectin based thin films for memristor behavior.

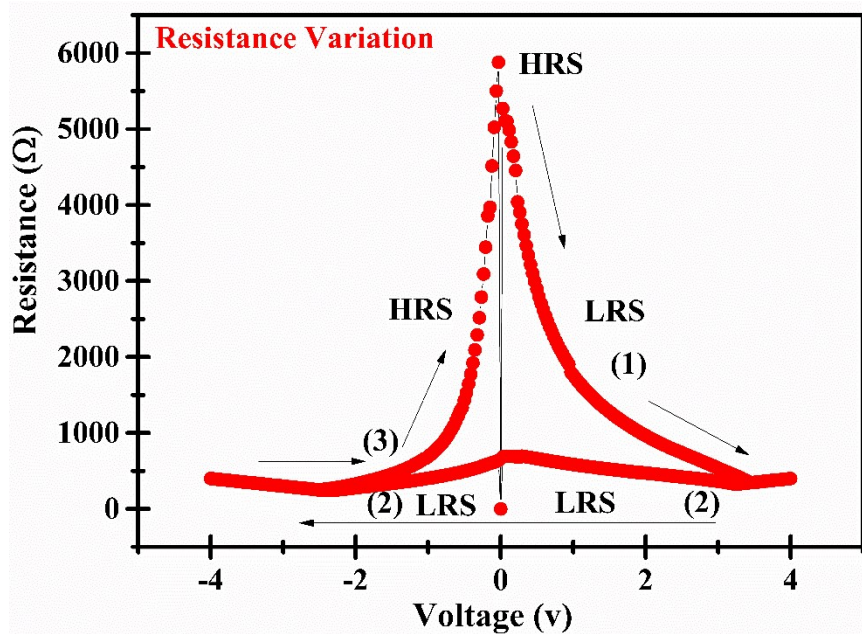


Figure 3. Represents the resistance variation profile of pectin based thin films where resistance switched into high and low resistance states under threshold electric stimuli.

Reference:

1. Ingham, B.; Toney, M., X-ray diffraction for characterizing metallic films. In *Metallic Films for Electronic, Optical and Magnetic Applications*, Elsevier: 2014; pp 3-38.