Effect of bottom electrodes on the tunneling electro-resistance in P(VDF-TrFE) based hybrid ferroelectric tunnel junctions for non-volatile memories

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Manipulation of electronic properties at a single molecular scale by subjecting the molecules to external stimuli like electric or magnetic field holds promises for fascinating science and large range of applications. Recent years have witnessed huge surge in interest for ferroelectric tunnel junctions (FTJ) showing giant tunneling eletroresistance (TER) effect. The FTJs can write and read information using an applied voltage and retain data without any power supply and therefore can be used as non-volatile, energy efficient data storage elements. Here we report a robust, spontaneous, and electrically switchable TER at room temperature in few nano-meter thick, spin-coated films of ferroelectric co-polymer P(VDF-TrFE) (70:30) on different conducting oxide and metallic electrodes. A room temperature conductive-tip atomic force microscopy (AFM), piezo-force microscopy (PFM) and tunneling AFM (TUNA) measurements on the P(VDF-TrFE) thin films on conductive Indium Tin Oxide (ITO), $La_{0.67}Sr_{0.33}MnO_3$ (LSMO), Nb-doped SrTiO3 (Nb-STO) and Au substrates clearly demonstrate that large TER arises due to electrically induced polarization reversal in P(VDF-TrFE) molecules. Time dependent measurements reveal written domains are most stable on the Nb-STO bottom electrodes (Fig. 1) followed by LSMO, ITO and Au bottom electrodes. This finding is of utmost importance for non-volatile hybrid resistive memory elements working under ambient conditions. Also easy, large area and low temperature processing technique of the hybrid devices hold promises for additional advantages of low cost, printable, greener technology solutions for future.

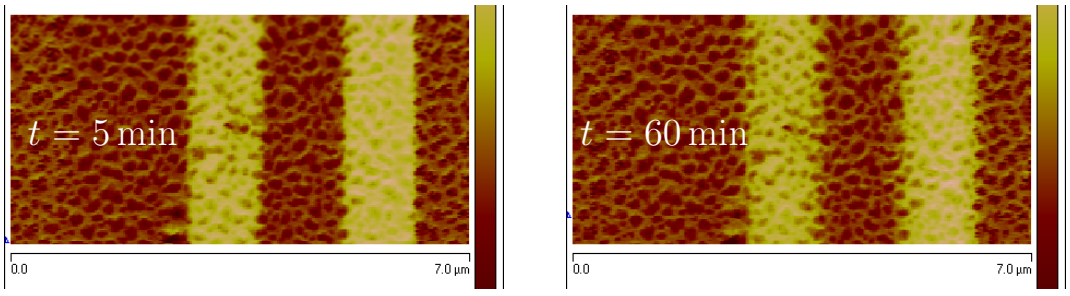

Fig. 1: Kelvin-probe force microscope (KPFM) image of surface potential (left) just after writing and (right) 1 hour after writing on P(VDF-TrFE) films on Nb-STO bottom electrodes showing stable data retention capacity.

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