Bistable Resistive Switches Fabricated by Multilayered Coating of Semiconducting Conjugated Polymers

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Semiconducting conjugated polymers (SCPs) have gained a lot of attentions in terms of their applications in the various technological domains and are one of the promising candidates amongst organic semiconductors in the field of organic electronics. The solution-processable conjugated polymers as organic semiconductors are taking the center-stage as the choice of materials used for the printable organic electronics. Depending on the nature of the devices under consideration, there is a need for the fabrication of large area, uniform, and oriented thin films with controllable thickness and thin-film morphology. The multilayered organic device structure is highly desired for compact and flexible electronic circuits. However, it is quite challenging to fabricate them through common solution processes due to unavoidable damage caused to the underlying layers. To circumvent this issue, advantage of floating-film transfer method (FTM) was utilized for the layer-by-layer coating of SCP film after its fabrication at the orthogonal liquid surface. By sandwiching a layer of metal nanostructures between the SCP films, resistive switches were fabricated in device architecture as shown in Fig. 1.

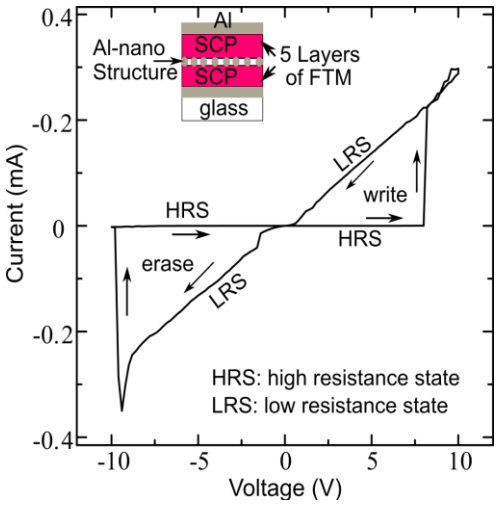

Fig. 1. Representative electrical response for bistable resistive switches fabricated in the device structure shown in the inset.

In this work, resistive switching was realized by creating HRS (high resistance state) and LRS (low resistance state) by varying the applied potential. Further, effect of the nature of the polymeric backbone on the device performance was also studied by utilizing different solution processable SCPs from the Thiophene-based polymers. Subsequently, it was revealed that the SCP with relatively higher hydrophilic side chains was more favorable due to facile vertical charge transport assisted by their preferred face-on conformation on the hydrophilic liquid substrate used under FTM in this work. On the other hand, the SCPs with more hydrophobic side-chains led to edge-on conformation, which consequently inhibited the vertical charge transport. The bistable resistive switches were demonstrated with solution-processed layer-by-layer polymer films having Aluminum nano structures in the middle as shown in Fig. 1, which will be discussed in detail during my presentation.