SUPPORTING INFORMATION

Water-soluble Polymer Dielectric toward High Performance Organic Thin-Film Transistors

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Experimental

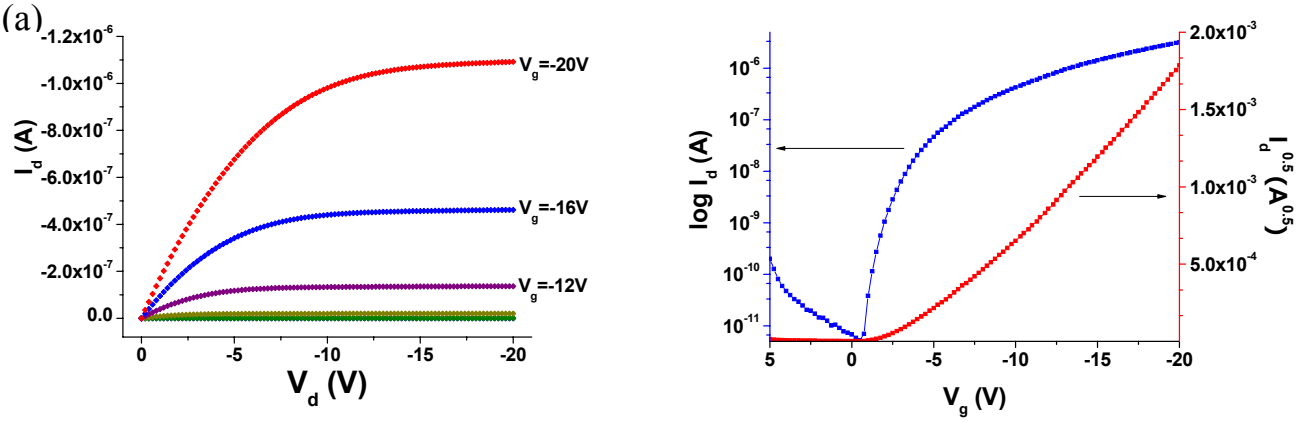
Materials: poly(acrylic acid) (PAA, 35 wt% in H_2O, MW=100,000), poly(4-vinyl phenol) (PVP, MW=25,000), ethylene glycol, 1,4 benzenedimethanol, poly(melamine-co-formaldehyde), propylene glycol monomethyl ether acetate (PGMEA), Yttrium oxide (Y_2O_3, 5 wt% in H_2O), pentacene were purchased from Aldrich.

Fabrication of the OTFT: The structure of OTFT was fabricated in bottom-gate, top-contact configuration. During the processing, the indium tin oxide (ITO, 180 nm thick) glass as a gate electrode was cleaned with trichloroethylene, acetone, and isopropyl alcohol. Onto the ITO glass, 15 wt% poly(acrylic acid) (PAA, MW=100,000) was spin-coated. The PAA dielectric layer was prepared from solutions of PAA and ethylene glycol as the cross-linking agent, in DI water. The film was spin-coated at a speed of 4000 rpm and prior to spin-coating, the substrate was exposed to UVO for 30 min to uniformly coat the overall surface. Then the film was annealed at 150 °C for 2 hours in a vacuum oven. The thickness of the PAA film was approximately 400 nm as measured by using a ST-2000DLX, thickness controller. Also, the poly(4-vinyl phenol) solution was prepared with a cross-linking agent poly(melamine-co-formaldehyde) in propylene glycol monomethyl ether acetate (PGMEA). The OTFT fabrication began with a PVP dielectric layer on top of the ITO substrate, using spin-coating at 3000

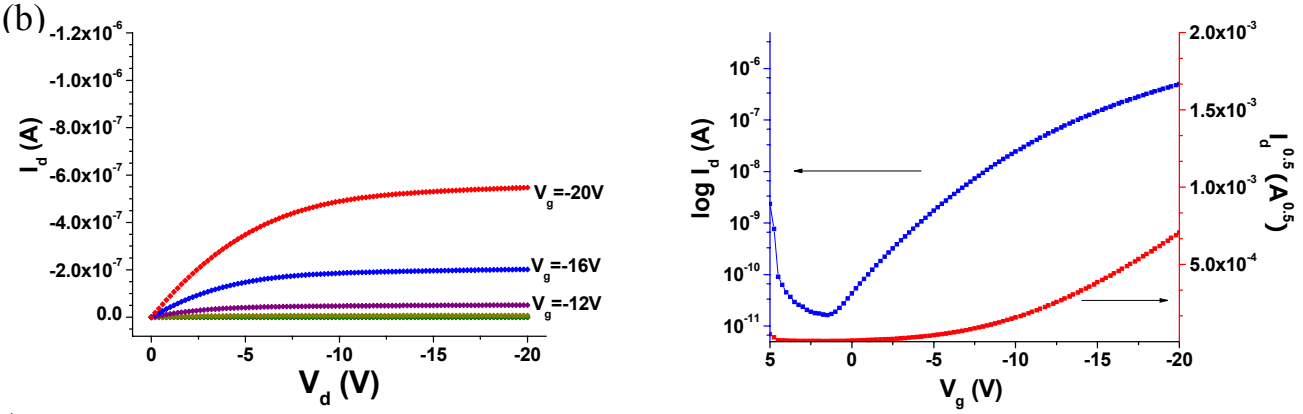
rpm. After, the PVP thin film was annealed at 200 °C for 1 hour. Pentacene was deposited on the substrate through a shadow mask by thermal evaporation (50 nm, 0.4 °C /s). Finally, the source/drain Au electrodes were deposited by thermal evaporation. The thicknesses of the electrodes were 100 nm. The fabricated OTFTs have a channel length of 150 μm and channel width of 1000 μm.

The electrical characteristics of the OTFTs were measured by using an Agilent 5270B semiconductor parameter analyzer in the dark and an air ambient at RT.

(a)



(b)

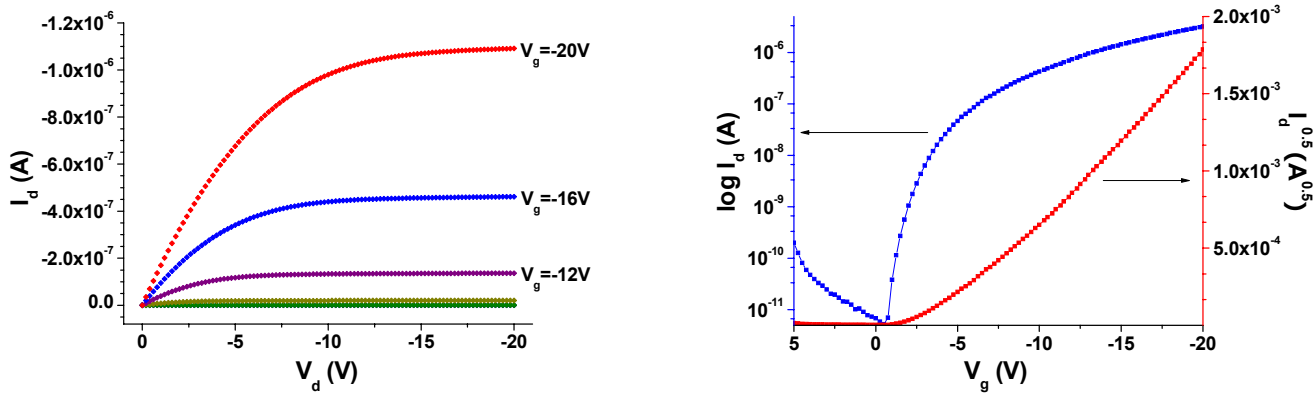


(c)

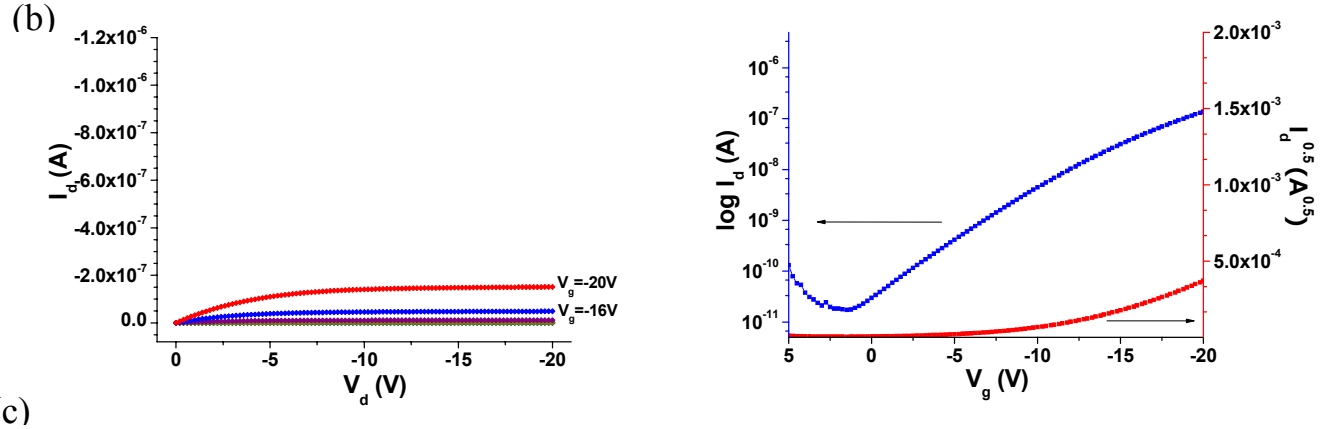
	Mobility ($cm^2/V{\cdot}s$)	Threshold voltage (V)	On/off ratio
OTFT using cross-linked PAA-EG dielectric layer	0.53	-4.1	$6.1x10^5$
OTFT using non cross-linked PAA dielectric layer	0.08	-7.7	$3.1x10^4$

Fig. S1 (a) Device performance of OTFT using cross-linked PAA dielectric layer, (b) device performance of OTFT using non cross-linked PAA dielectric layer, and (c) table of electrical performance of OTFTs using cross-linked PAA-EG dielectric layer and non cross-linked PAA dielectric layer

(a)



(b)



(c)

	Mobility ($cm^2/V \cdot s$)	Threshold voltage (V)	On/off ratio
OTFT using cross-linked PAA-EG dielectric layer	0.53	-4.1	6.1×10^5
OTFT using cross-linked PVP dielectric layer	0.01	-6.1	7.8×10^3

Fig. S2 (a) Device performance of OTFT using cross-linked PAA-EG dielectric layer, (b) device performance of OTFT using cross-linked PVP dielectric layer, and (c) table of electrical performance of OTFTs using cross-linked PAA-EG dielectric layer and cross-linked PVP dielectric layer respectively

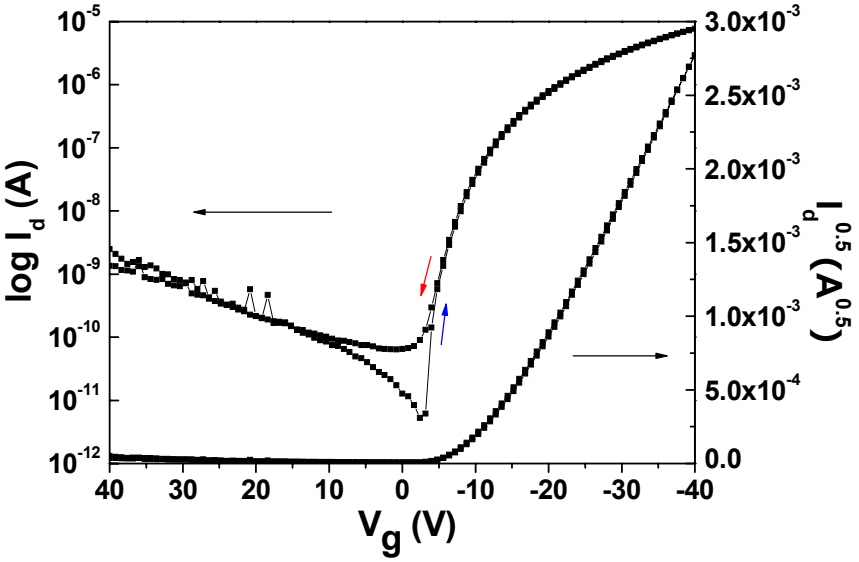


Fig. S3 Hysteresis in the transfer characteristics of the cross-linked PAA dielectric OTFT. The blue arrow indicates the forward sweep and the red arrow indicates the backward sweep.