Supporting Information

Novel Solution-Processable Functional Polyimide/ZrO_2 Hybrids with Tunable Digital Memory Behaviors

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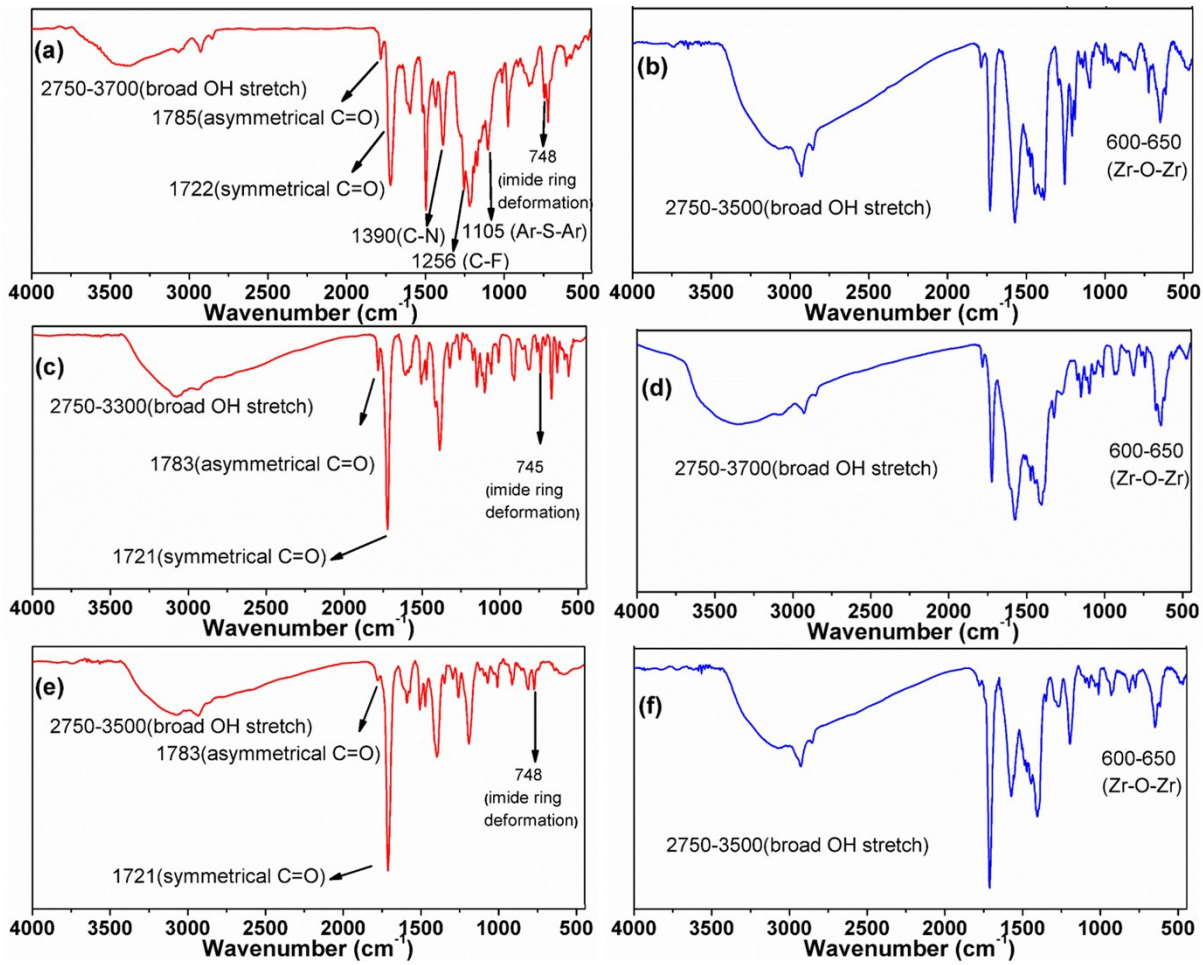

Figure S1. FT-IR spectra of the studied films (a) **3SOH-6FPI,** (b) **3S-6FZr30,** (c) **3SOH-DSPI,** (d) **3S-DSZr30,** (e) **3SOH-CHPI,** (f) **3S-CHZr30**.

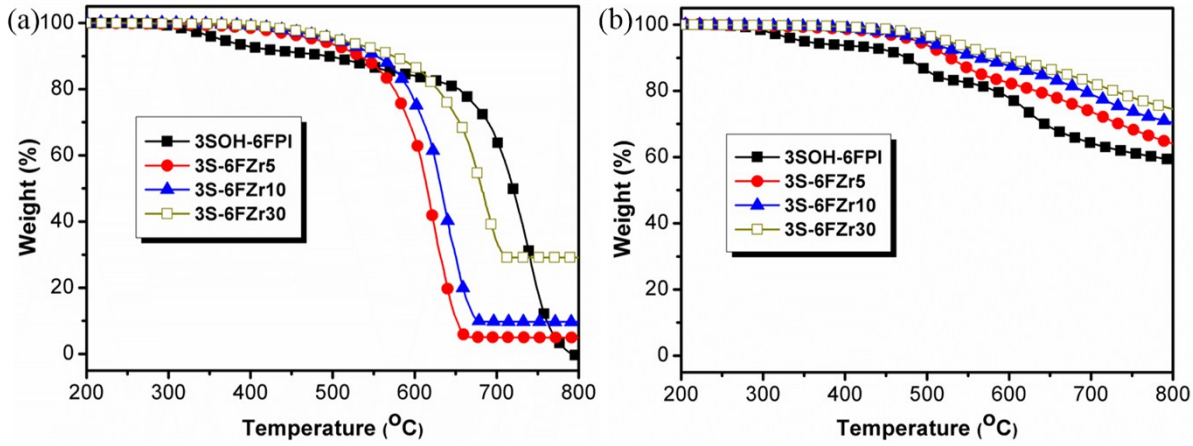

Figure S2. TGA thermograms of the **3SOH-6FPI** hybrid materials in (a) air (b) nitrogen.

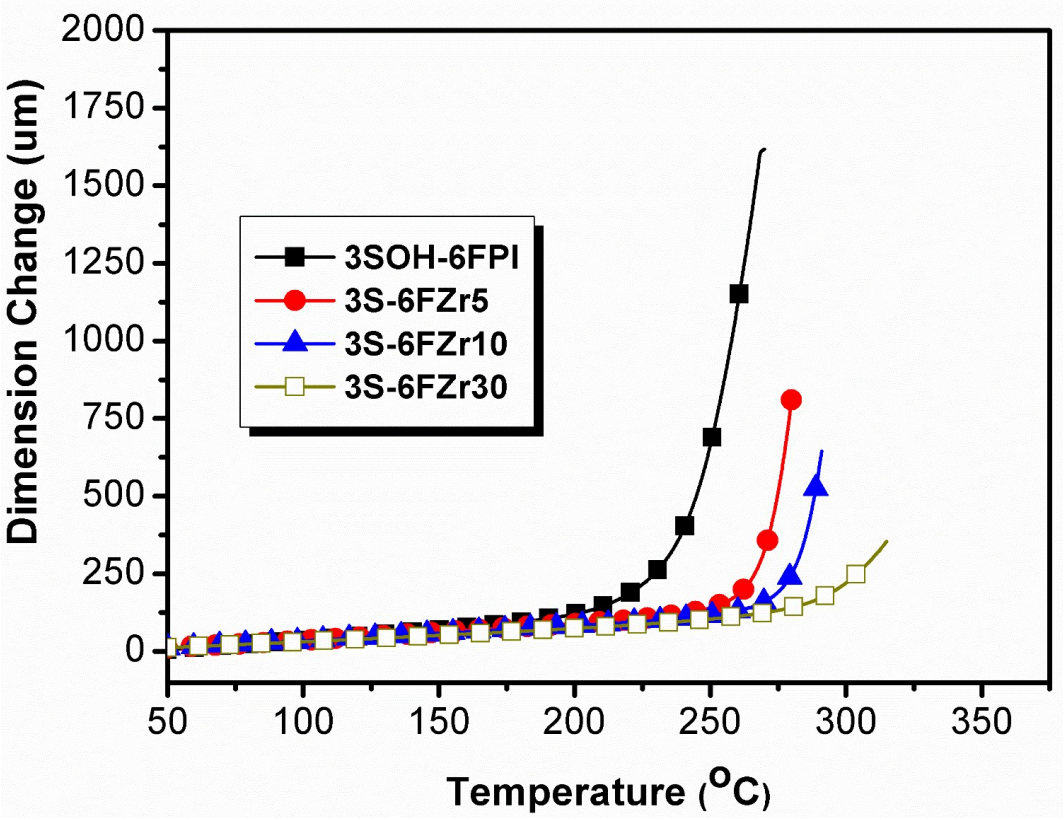

Figure S3. TMA thermograms of the **3SOH-6FPI** hybrid materials.

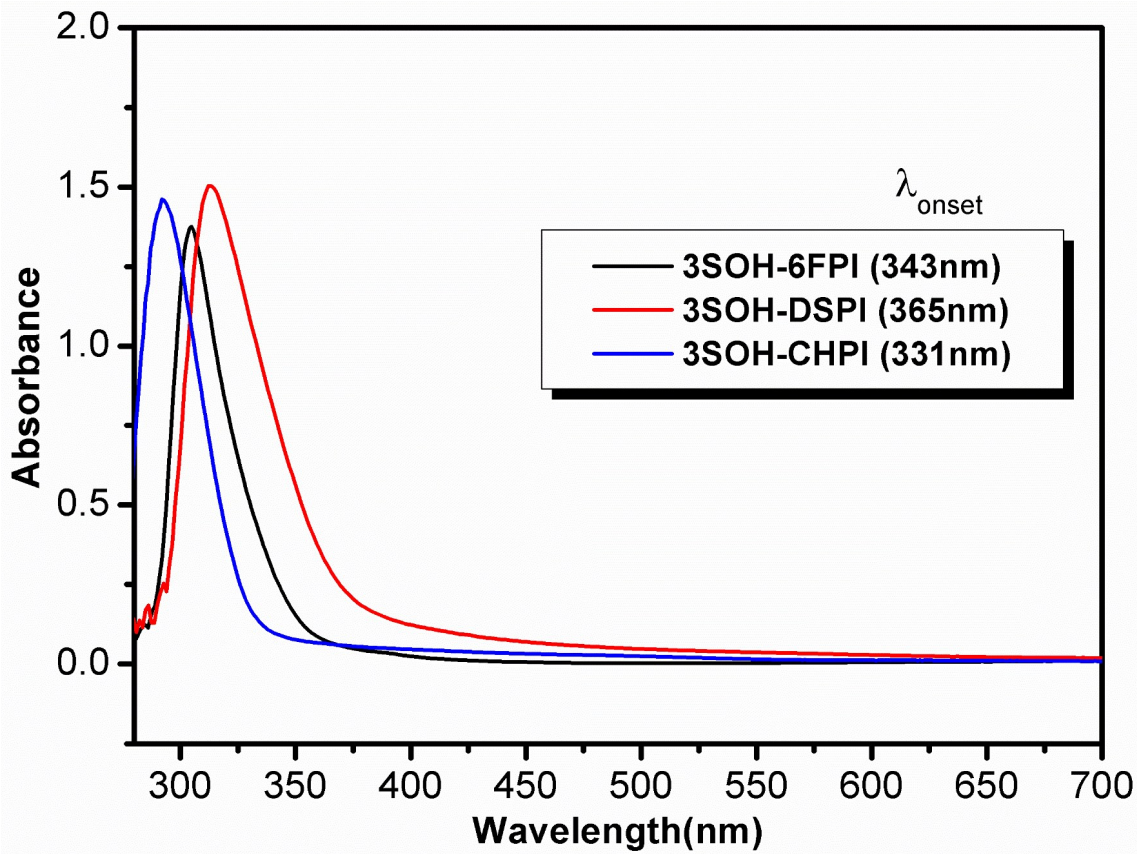

Figure S4. UV-visible absorption spectra of the **3SOH-RPI**.

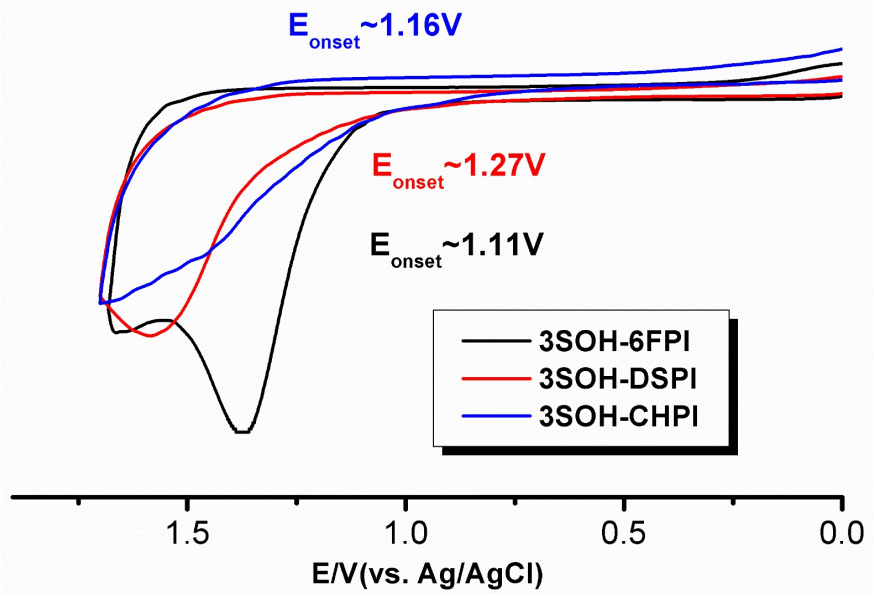

Figure S5. Cyclic voltammetric diagrams of the **3SOH-RPI** films on an ITO-coated glass substrate over cyclic scan.

Table S1. Inherent Viscosities and GPC Results of the **3SOH-RPI**.

Polymer	η_{inh}[a] (dL/g)	M_w[b]	M_n[b]	PDI[c]
3SOH-6FPI	0.51	103200	52800	1.95
3SOH-DSPI	0.67	130800	65000	2.01
3SOH-CHPI	0.42	93800	49600	1.89

[a] Measured at a polymer concentration of 0.5 g/dL in DMAc at 30 °C.

[b] Calibrated with polystyrene standards, using NMP as the eluent at a constant flow rate of 0.5 mL/min at 40 °C.

[c] Polydispersity index (M_w/M_n).

Table S2. Solubility[a] of the **3SOH-RPI**.

Polymer	Solvents						
	NMP	DMAc	DMF	DMSO	*m*-cresol	THF	$CHCl_3$
3SOH-6FPI	++	++	++	++	++	++	−
3SOH-DSPI	++	++	++	++	++	−	−
3SOH-CHPI	++	++	++	++	−	−	−

[a] The qualitative solubility was tested with 10 mg of a sample in 1 mL of stirred solvent. (++) soluble at room temperature, (+) soluble on heating, (−) insoluble even on heating.

Table S3. Thermal properties of the hybrid films with ZrO_2

Index	**Thermal Properties**							**Inorganic content** (wt%)	
	T_g (°C) [a]	CTE (ppm/K) [b]	T_d^5 (°C) [c]		T_d^{10} (°C) [c]		R_{w800} (%) [d]	Theoretical	Experimental [e]
			N_2	Air	N_2	Air			
3SOH-6FPI	230	72	350	460	475	490	59	-	-
3S -6FZr5	265	69	490	480	525	530	63	5	4.8
3S -6FZr10	276	60	495	490	560	555	70	10	9.8
3S -6FZr30	287	52	520	505	595	570	73	30	29.7
3SOH-DSPI	198	78	405	395	460	455	62	-	-
3S –DSZr5	239	67	445	440	490	490	67	5	4.9
3S –DS Zr10	251	55	460	465	515	500	73	10	9.8
3S –DS Zr30	278	43	485	480	535	525	78	30	29.6
3SOH-CHPI	288	69	385	395	430	435	56	-	-
3S -CHZr5	335	67	425	420	445	440	61	5	4.8
3S -CHZr10	357	63	430	425	465	450	67	10	9.7
3S -CHZr30	360	51	440	435	470	460	74	30	29.8

[a] Glass transition temperature measured by TMA with a constant applied load of 10 mN at a heating rate of 10 °C min^{-1} by tension mode. [b] The CTE data was determined over a 50–200 °C range by tension mode. [c] Temperature at which 5% and 10% weight loss occurred, respectively, recorded by TGA at a heating rate of 20 °C/min and a gas flow rate of 30 cm^3/min. [d] Residual weight percentages at 800 °C under nitrogen flow. [e] Experimental inorganic content estimated from TGA curves.