

Supplementary information

A generic approach for aligning liquid crystals using solution-processed 2D materials on ITO-free surfaces

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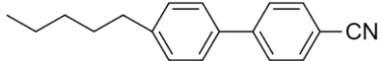
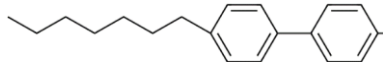
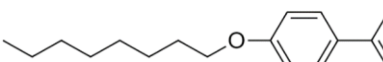
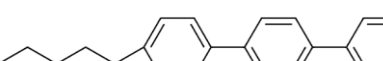
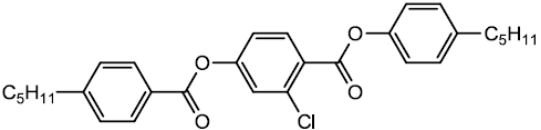
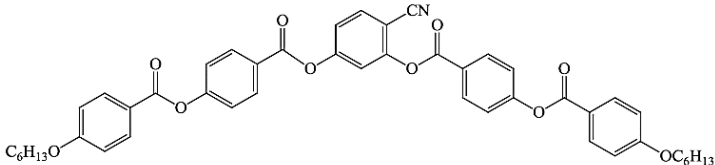
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Table S1: Table showing the molecular structure and transition temperature of the materials employed for the study

Compound	Molecular formula	Phase sequence
E7	 5CB (51%)	I (57 °C) N
	 7CB (25%)	
	 8OCB (16%)	
	 5CT (8%)	
E44	Structure not known	I (118 °C) N
ZLI-2359	Structure not known	I (70.4 °C) N
PCPBB		I (124 °C) N
6OCN		I (135 °C) N

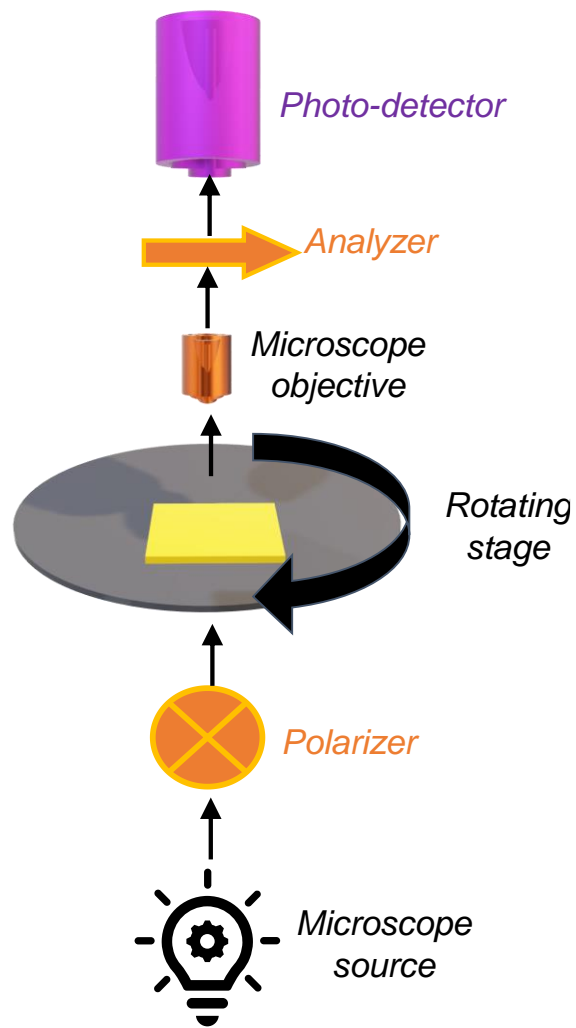


Figure S1: Schematics of the POM setup to collect the transmitted intensity upon sample rotation in azimuthal direction

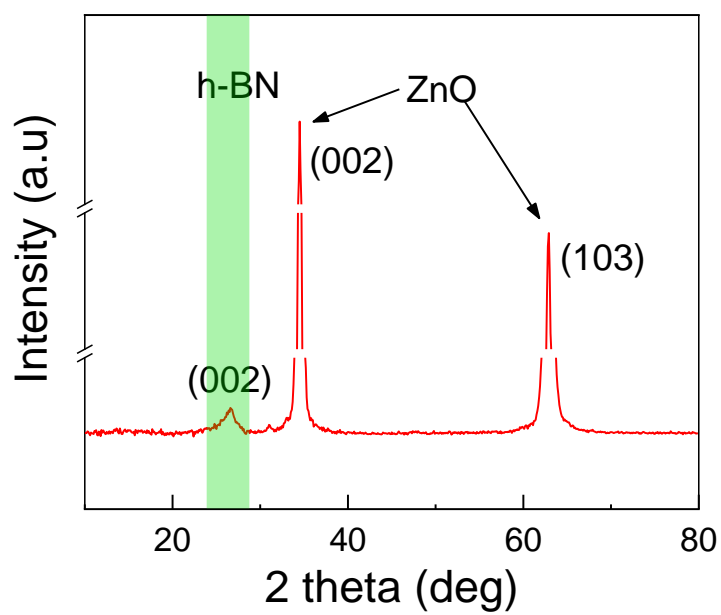


Figure S2: XRD plot of *h*-BN/AZO substrate. The region marked in green shows the diffraction from the (002) plane of *h*-BN. The diffraction from other planes corresponding to ZnO is also marked.

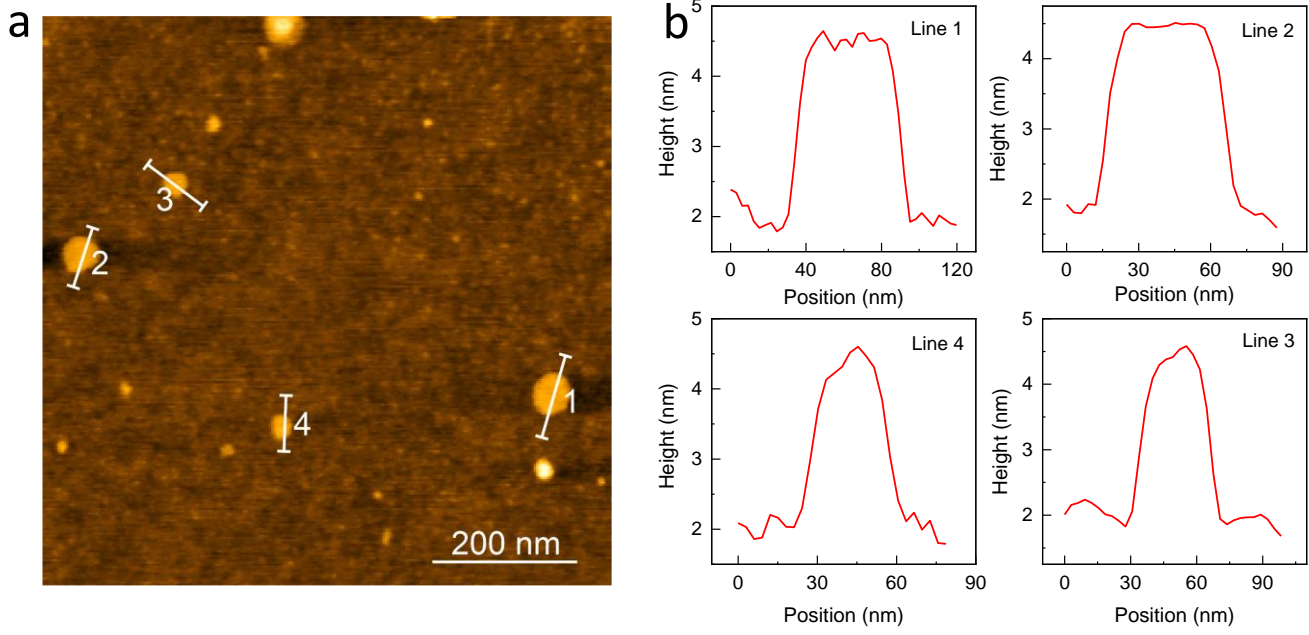


Figure S3: (a) AFM topography image of h-BN nanosheets, (b) line profiles showing the thickness of the various nanosheets.

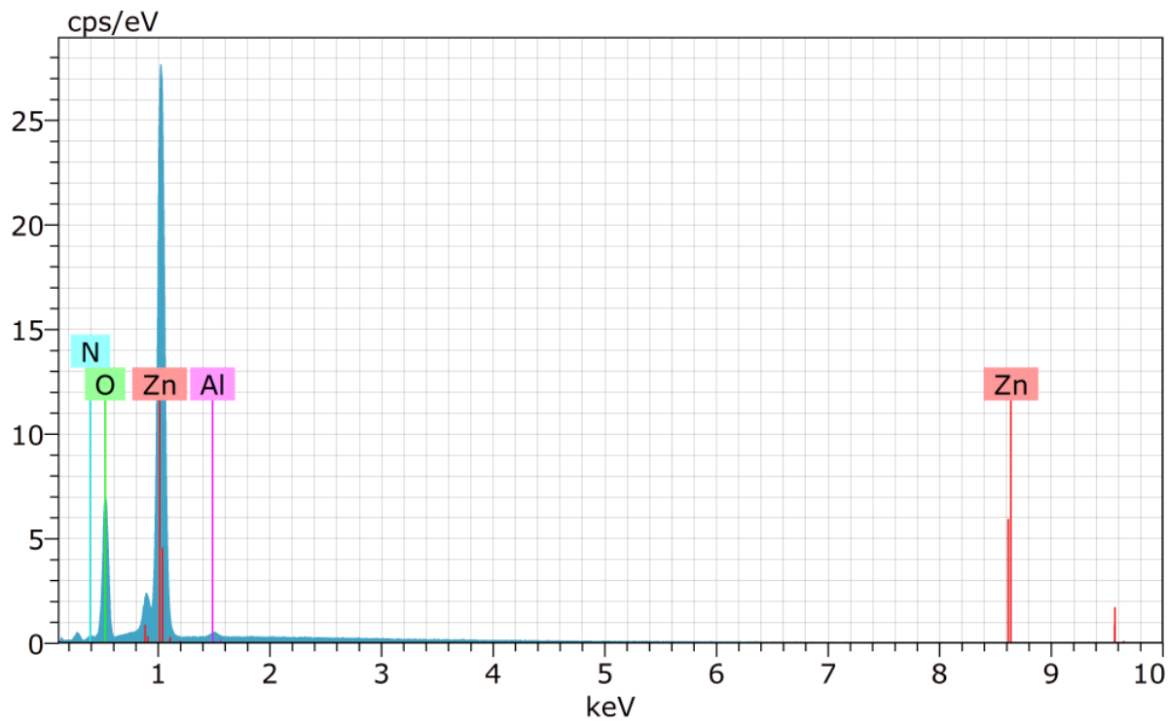


Figure S4: Energy dispersive X-ray (EDX) spectrum of h-BN/AZO substrate

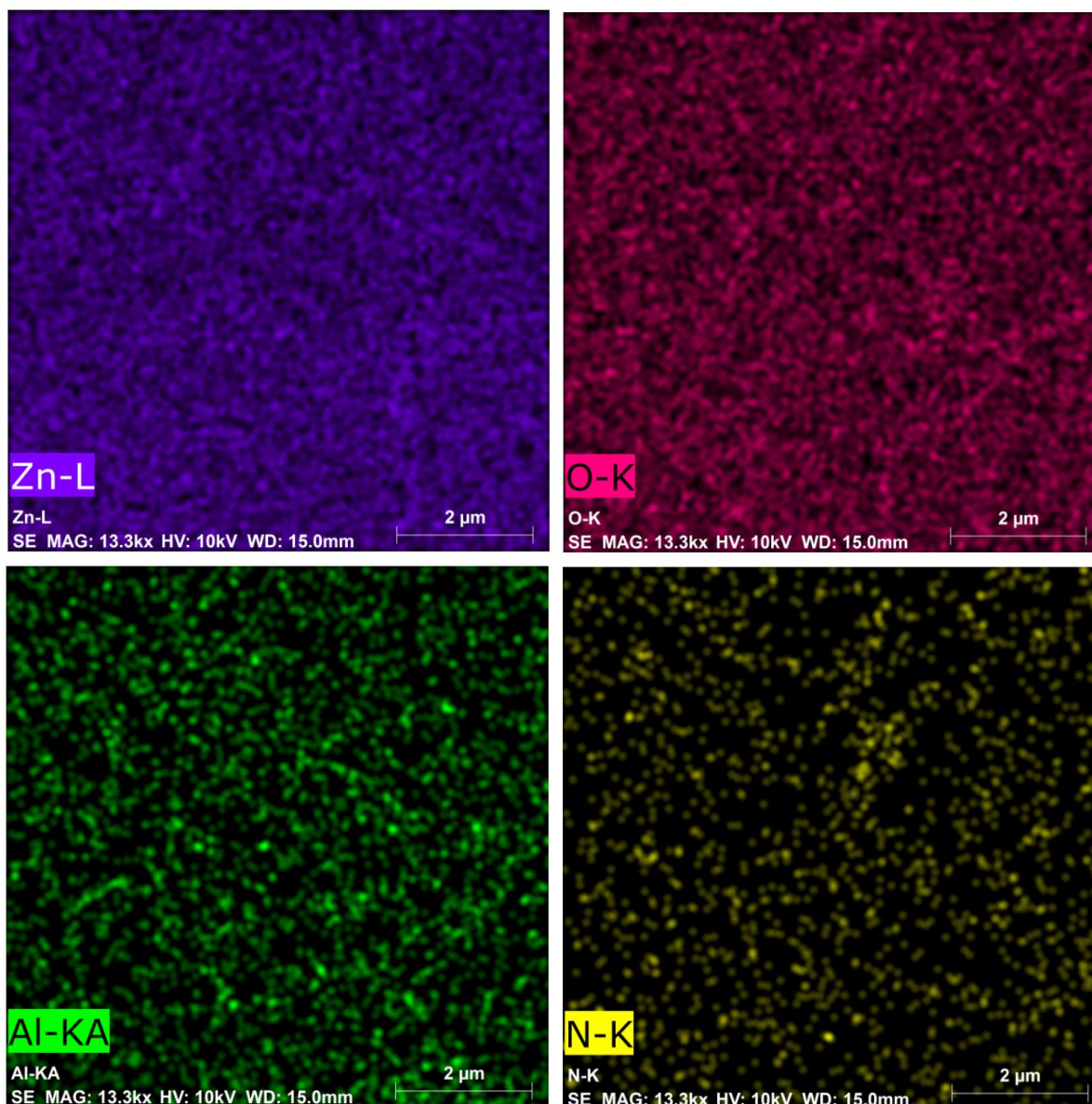


Figure S5: *Elemental mapping of Zinc, oxygen, aluminium and nitrogen in the h-BN/AZO substrate*

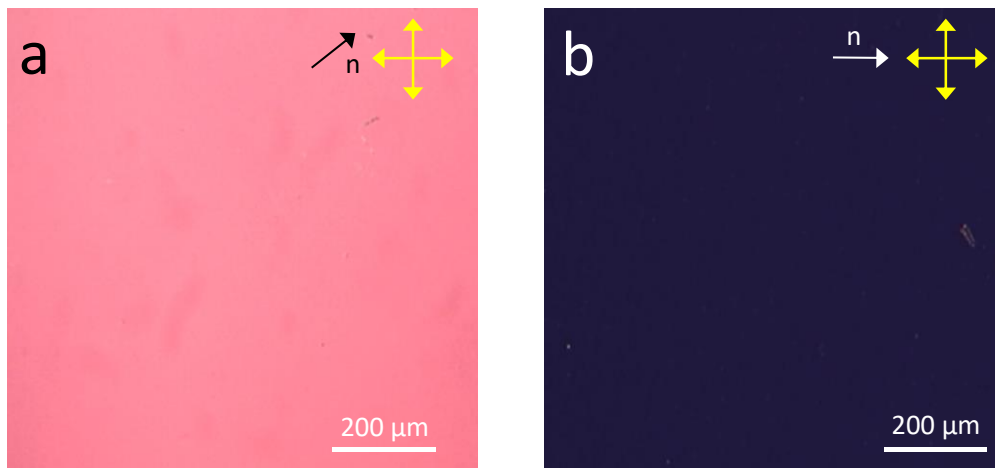


Figure S6: *Alignment of E7 in the commercial PI/ITO cell. The director orientation (n) cell is (a) at 45° , and (b) at 0° with respect to the polarizer/analyzer orientation respectively.*

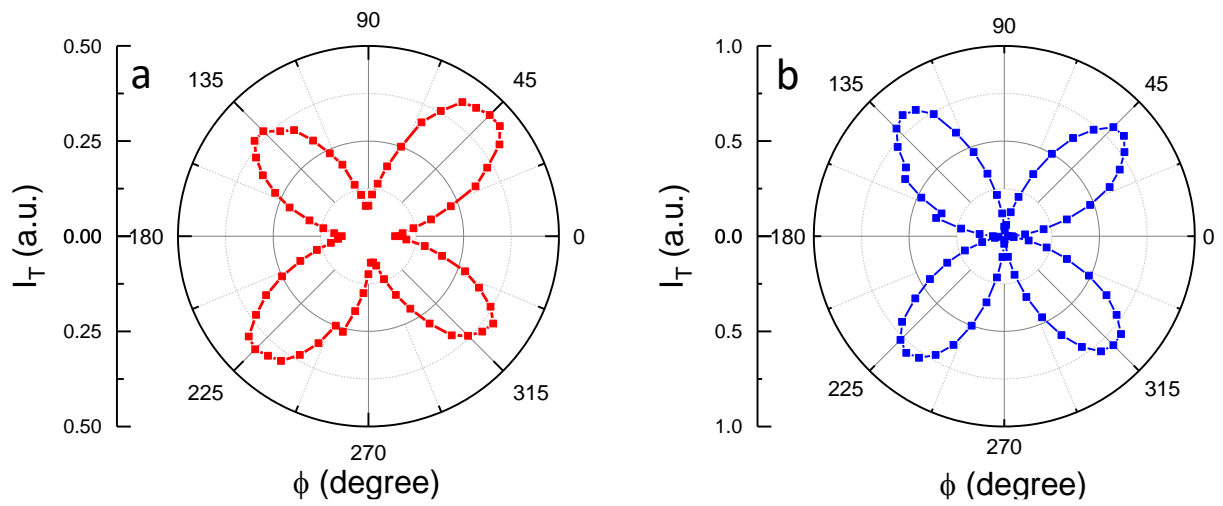
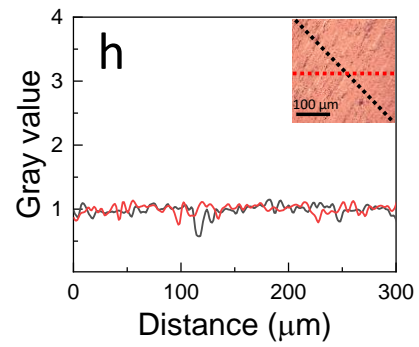
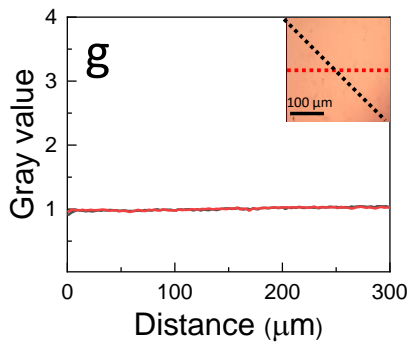
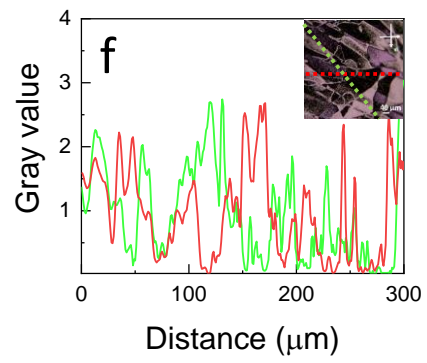
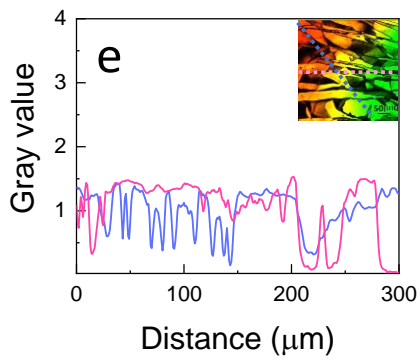
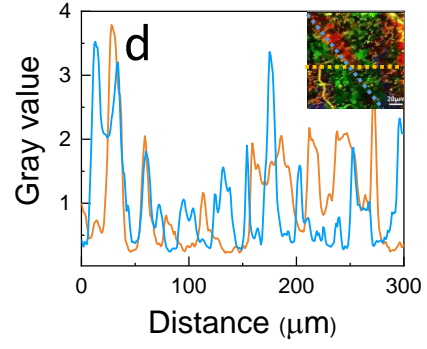
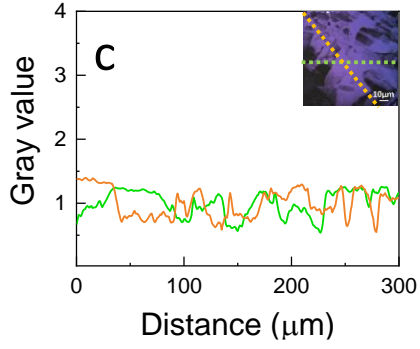
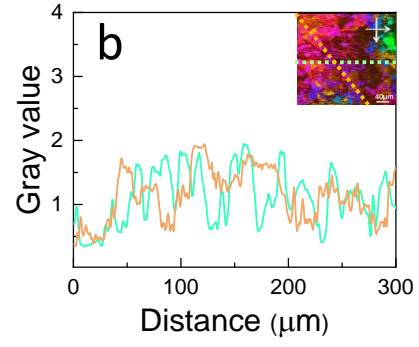
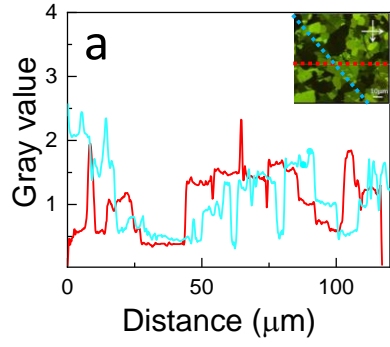
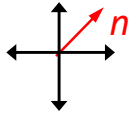


Figure S7: Polar plot of transmitted intensity (I_T) vs. azimuthal rotation for E7 in (a) *h*-BN/ITO cell and (b) PI/ITO cell



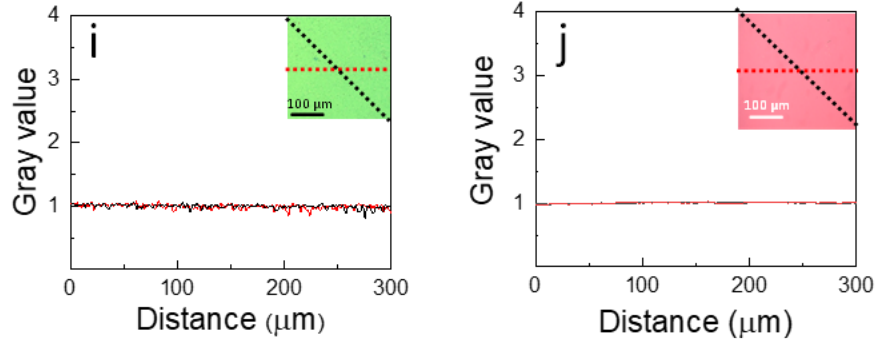


Figure S8: Measurement of birefringence intensity variation along two different lengths of the POM image for (a) CVD HOPG, (b) CVD h-BN, (c) CVD MoS₂, (d) CVD HOPG/PVA, (e) CVD WSe₂, and (f) CVD MoSe₂ cell filled with 5CB taken from Ref. 37, Ref. 39 and Ref. 40. Birefringence intensity variation in ITO/h-BN cell filled with (g) ZLI-2359, (h) E44, and (i) E7. (j) Birefringence variation of E7 filled in PI/ITO cell. Insets show the corresponding POM image taken for analysis. The dotted line indicates the path along which the gray value is measured.

Table S2: Mean and standard deviation obtained from the birefringence analysis of the POM images and compared with the literature values

Conducting / underlying layer	Aligning layer	LC used	Mean Gray value	Standard deviation	References
ITO	CVD-h-BN	E7	168	9.6	<i>Ref 32</i>
Silicon	CVD-h-BN	5CB	84	35	<i>Ref 40</i>
Silicon	CVD-graphene	5CB	54	27.2	<i>Ref 40</i>
Silicon	CVD-MoS ₂	5CB	110	21.1	<i>Ref 40</i>
Glass	CVD-HOPG/PVA	5CB	51	39	<i>Ref 39</i>
Silicon	CVD MoSe ₂	5CB	53	41.5	<i>Ref 37</i>
Silicon	CVD WSe ₂	5CB	91	28.1	<i>Ref 37</i>
ITO	EPD-h-BN	E7	173	5.1	<i>Ref 31</i>
ITO	EPD-h-BN	E44	175	8.9	This work
ITO	EPD-h-BN	ZLI-2359	185	2.8	This work
AZO	EPD-h-BN	E7	112	1.4	This work
AZO	EPD-h-BN	E44	124	1.8	This work
AZO	EPD-h-BN	ZLI-2359	107	4.2	This work

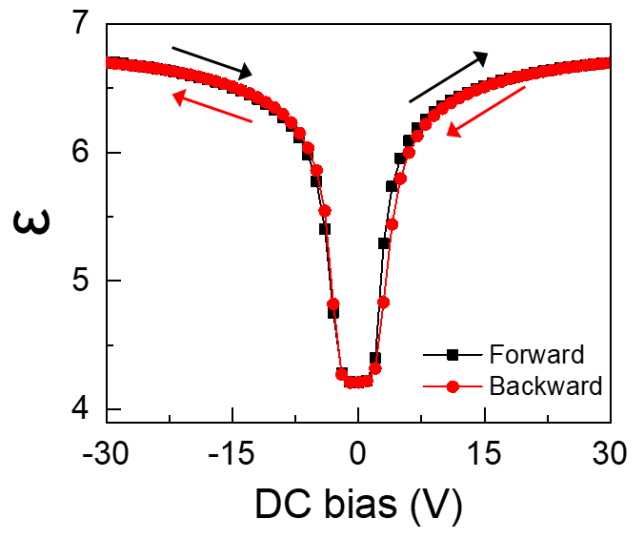


Figure S9: *Forward and backward dielectric response curves with applied DC bias (-30 V to +30 V) for PI/ITO layer*