Supporting Information

Control of Periodic Defect Arrays of 8CB (4'-n-octyl-4-cyano-biphenyl) Liquid Crystal by Multi-directional Rubbing

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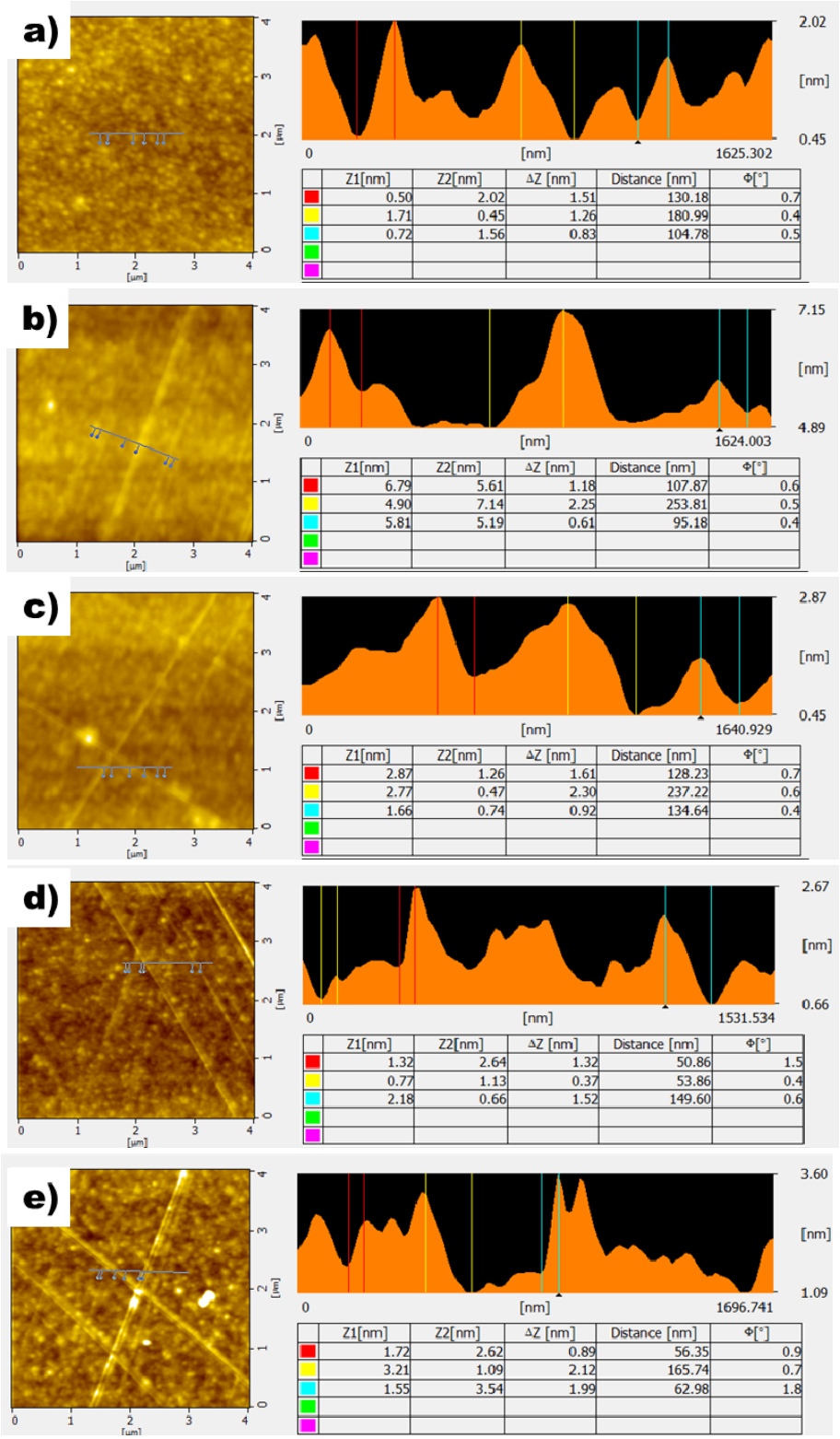


Fig. S1 AFM images and surface profiles of (a) Pristine PI substrate, (b) Unidirectional rubbed PI substrate, (c-e) Multidirectional rubbed PI substrate with 90°, 45°, and 60°-rubbing angle, respectively.

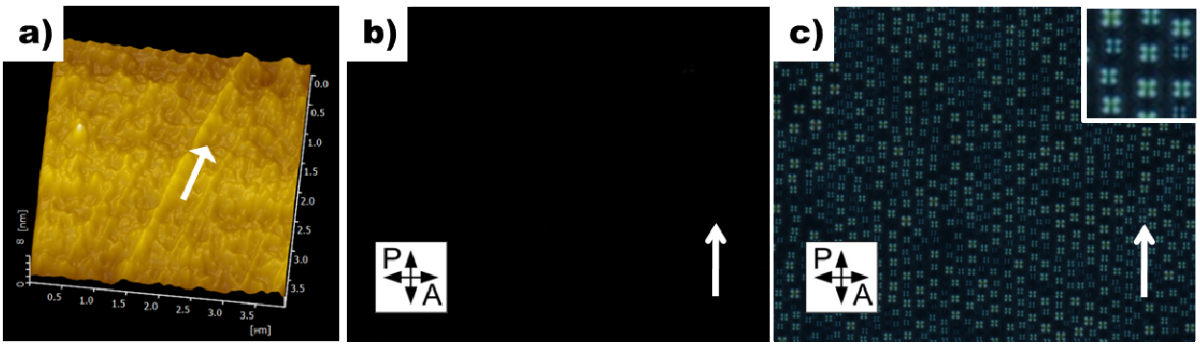


Fig. S2 (a) AFM image (4 x 4 mm^2) for the top surface of unidirectional rubbed PI substrate. (b, c) POM images of 8CB on the unidirectional rubbed PI substrate. (b) Black texture at the nematic phase. Optical axis of LC molecules aligned homogenously along upward rubbing direction is parallel to one of the polarizer. (c) One dimensional array of TFCD at the SmA phase. Inset is magnified image. White arrows indicate rubbing direction. (Scale bar: 20μm)

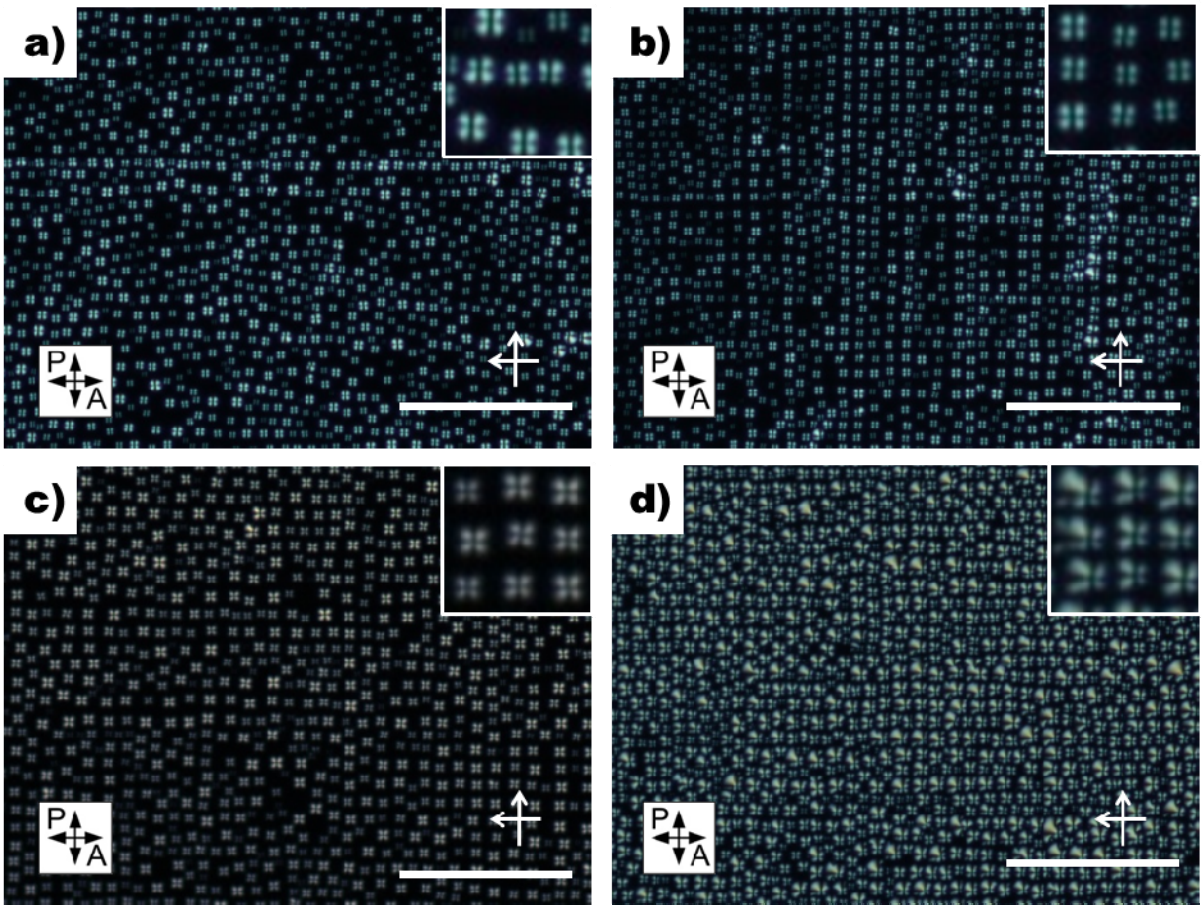


Fig. S3 POM textures of TFCD array on 90°-rubbed substrate with same rubbing condition of each rubbing direction. Degree of rubbing strength is (a)100 mm, (b)200 mm, (c)300 mm, (d)350 mm. Insets of (a, b, c, d) are magnified image. White arrows indicate rubbing directions (Scale bar: 50μm)

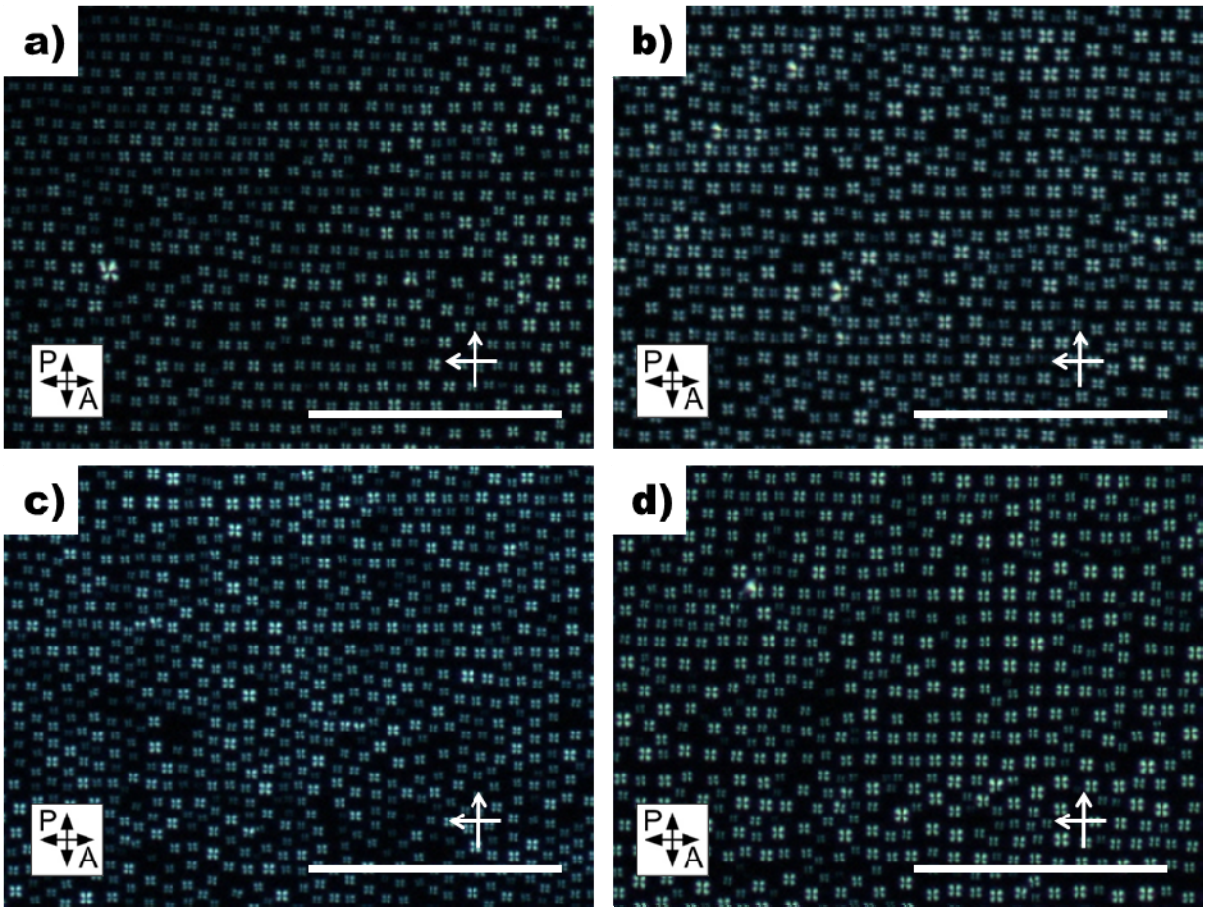
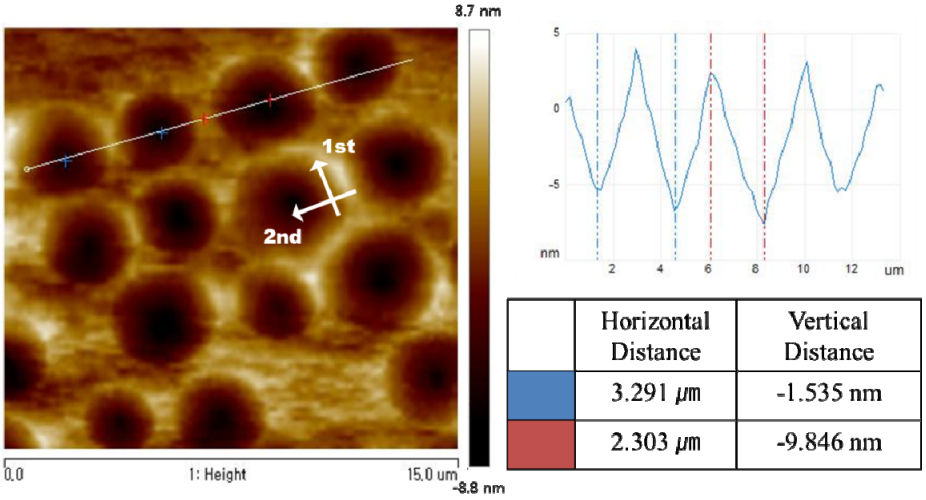


Fig. S4 POM textures of TFCD array on 90°-rubbed substrate with different rubbing condition of each rubbing direction. First rubbing direction is upward and second is leftward. The conditions of first-second rubbing strength are (a) 100mm-300mm, (b) 200mm-300mm , (c) 300mm-100mm, (d) 300mm-200mm, respectively. White arrows indicate rubbing directions (Scale bar: 50μm)



	Horizontal Distance	Vertical Distance
	3.291 μm	-1.535 nm
	2.303 μm	-9.846 nm

Fig. S5 AFM image and surface profile of TFCD array on 90°-rubbed substrate. Two white arrows indicate 1st and 2nd rubbing directions. The defect-induced surface depressions confirm the TFCDs and dimple-like structures of TFCDs were observed. Center to center of TFCDs is ~3.5 um and the depth of depressions is ~10 nm. The surface topological measurements were performed using a Bruker AFM (Multimode 8) in tapping mode. We used rectangular cantilevers with a resonance frequency of about 320 kHz and a force constant of 42N/m. The scanning speed was 0.3 Hz.

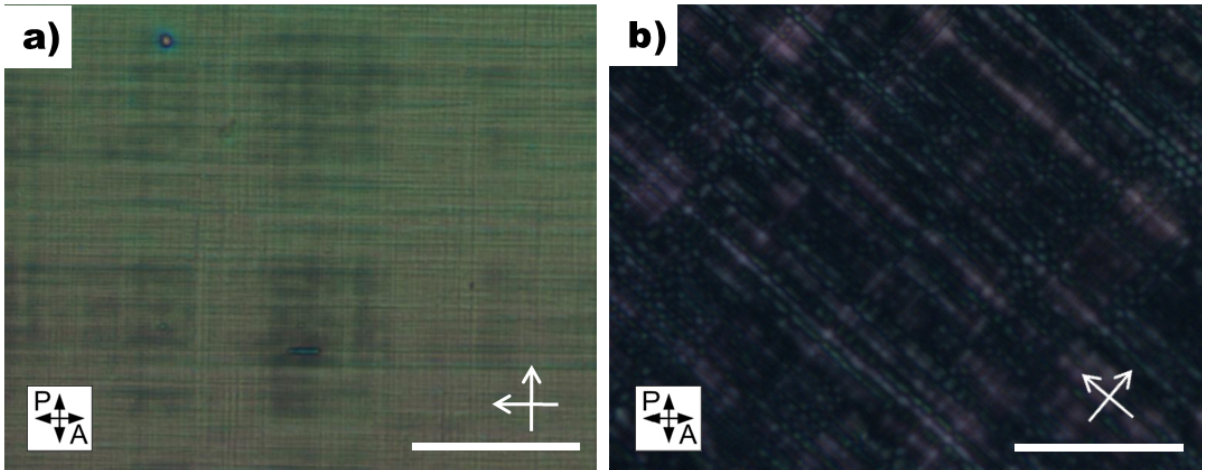


Fig. S6 POM textures of nematic phase of 8CB by rotating the sample on 90°-rubbed substrate. (a) Checker-board pattern at the nematic phase. (b) Black texture appears when the sample was rotated by 45degree. It means that LC molecules are aligned along intermediate angle between first and second rubbing directions. White arrows indicate rubbing directions. (Scale bar: 100μm)

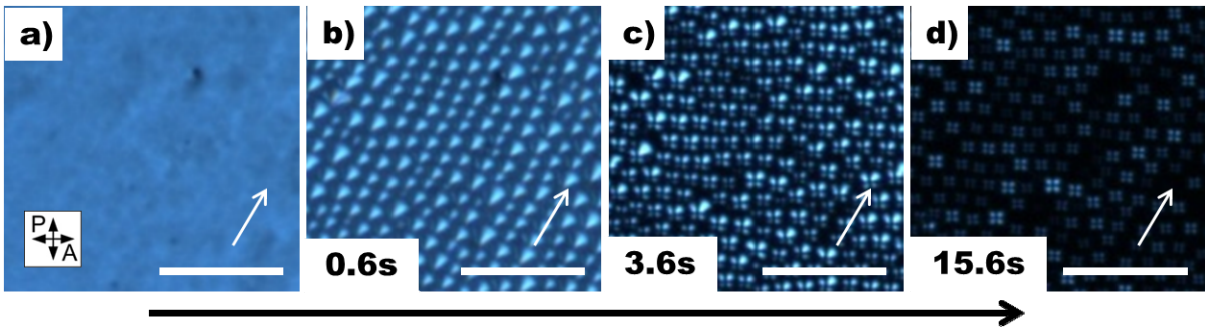


Fig. S7 POM textures during transition from nematic to SmA phase on unidirectional rubbed PI substrate. Texture change of 8CB at phase transition temperature, 33.5°C, for (a) 0s, (b) 0.6s, (c) 3.6s, and (d) 15.6s duration. White arrows indicate rubbing direction. (Scale bar: 20μm)

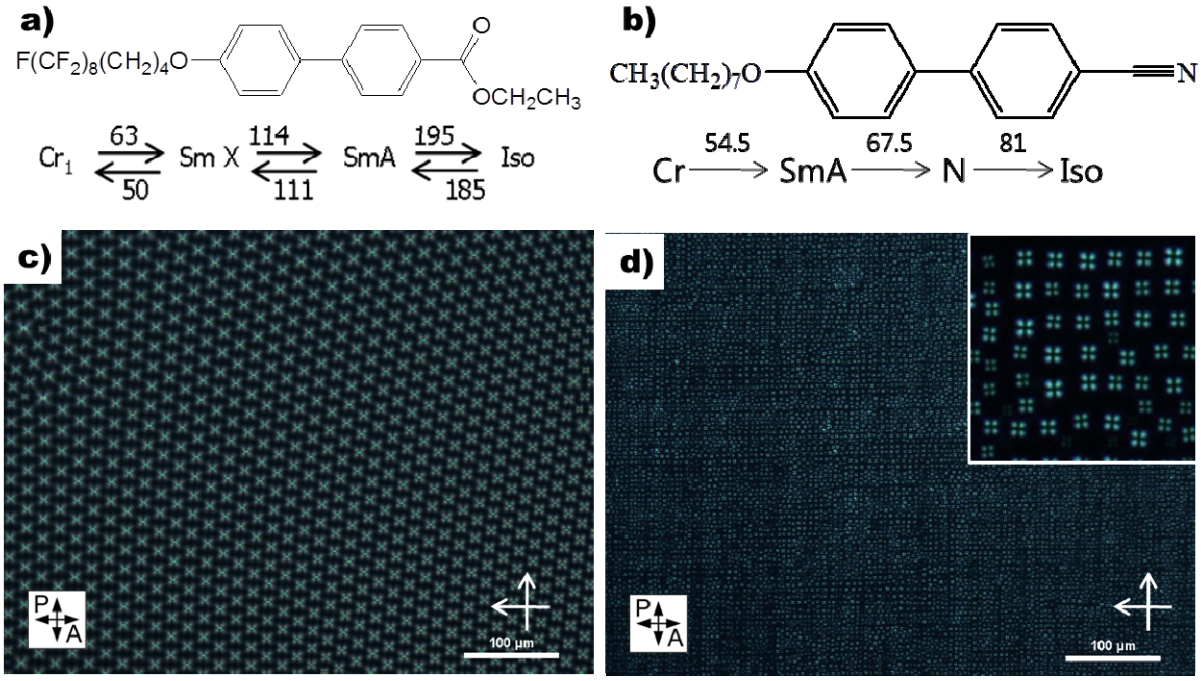


Fig. S8 Comparison with different SmA LC materials. Molecular structures and phase transition temperature of (a) semi-fluorinated SmA liquid crystal and (b) 8OCB. POM images of (c) hexagonal array of semi-fluorinated SmA liquid crystal and (d) square array of 8OCB on the 90°-rubbed substrate. Inset of (d) is magnified image. White arrows indicate rubbing direction