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Supplementary Materials for

3D touchless multiorder reflection structural color sensing display

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Figs. S1 to S10

Supplementary Materials

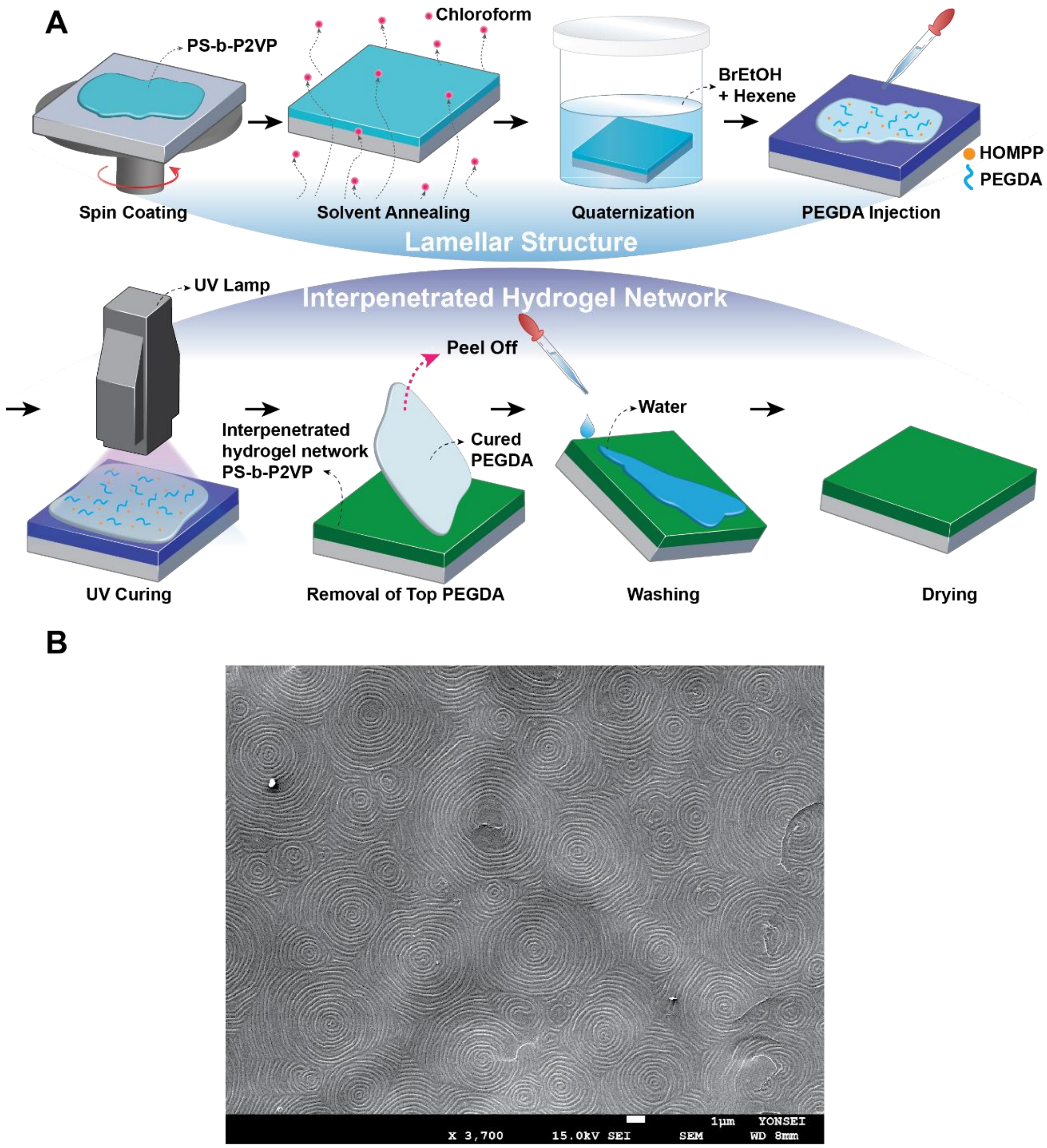
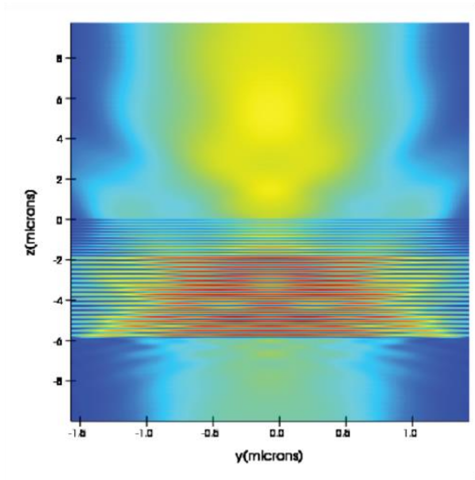
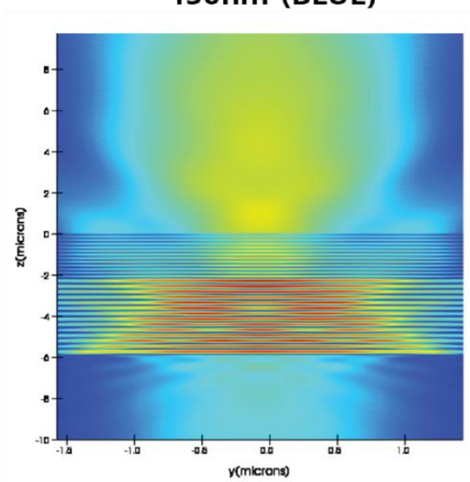


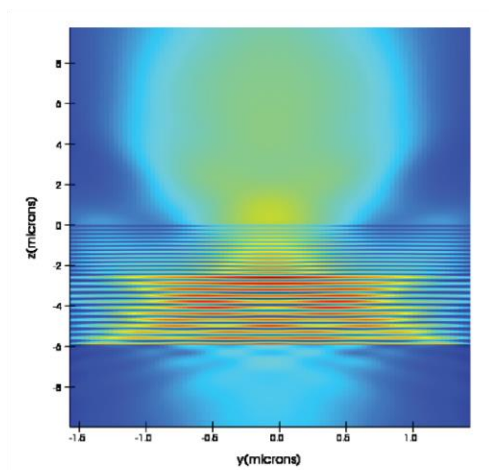
Fig. S1. Fabrication of interpenetrated hydrogel network BCP PC. (A) Schematic illustration of the fabrication processes of interpenetrated hydrogel network block copolymer photonic crystal (IHN BCP PC). (B) Surface morphology of a PS-*b*-QP2VP film swollen by ethanol, followed by being dried.



450nm (BLUE)



531nm (GREEN)



604nm (RED)

Fig. S2. Calculation of IHN BCP PCs with red, green and blue structural colors. Finite-difference time-domain (FDTD) simulation results of IHN BCP PCs with their SCs of red, green, and blue.

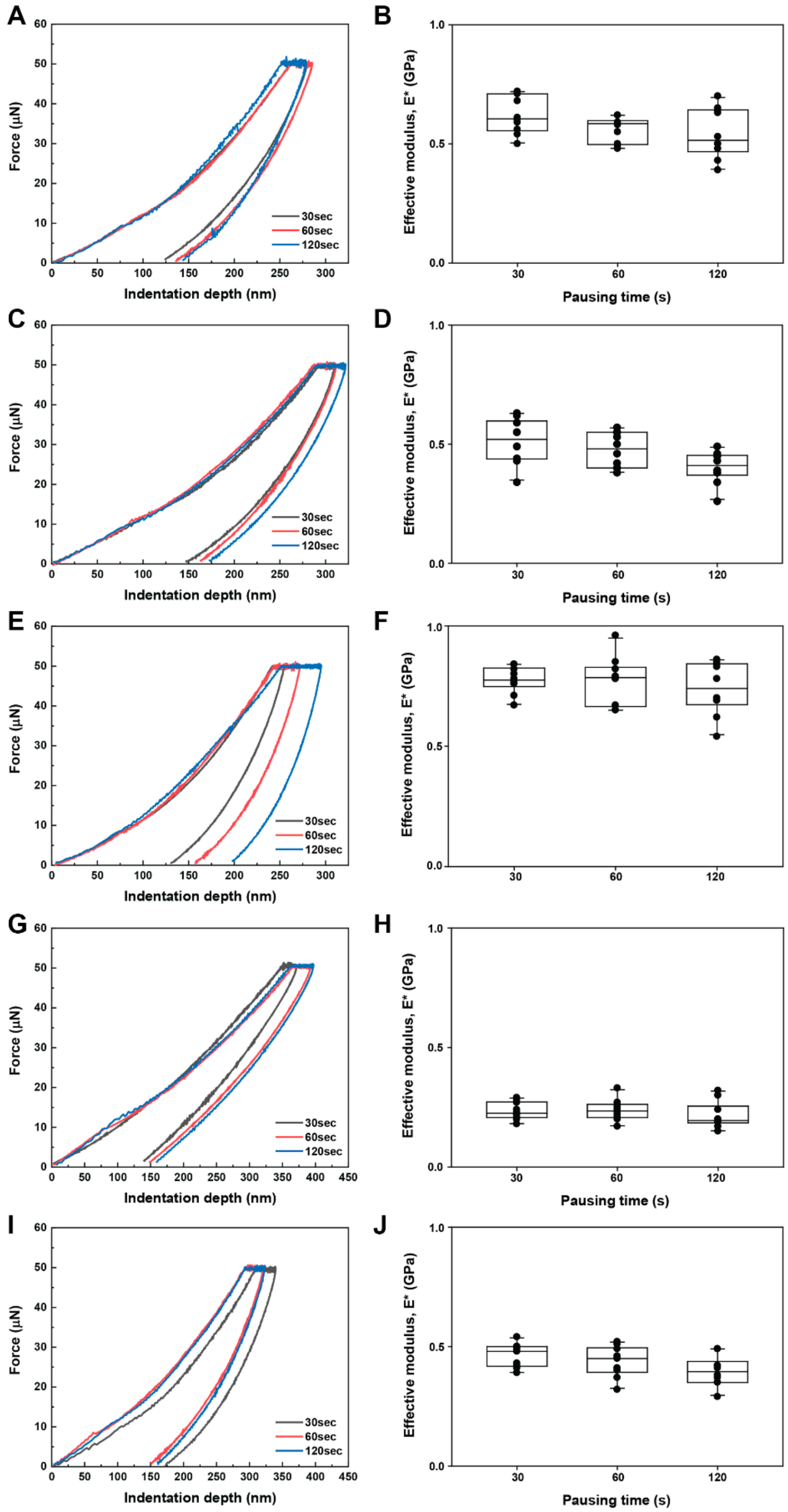


Fig. S3. Nano-indentation results of neat and ionic liquid doped IHN BCP PCs. Force-distance curves and effective moduli of IHN BCP PCs with their SCs of red (A and B), green (C and D), blue (E and F) and EMIMTFSI employed IHN BCP PCs with their SCs of red (G and H), green (I and J). All the nanoindentation experiments were performed with sequential loading, holding, and unloading, with different holding interval time of 30, 60 and 120 s.

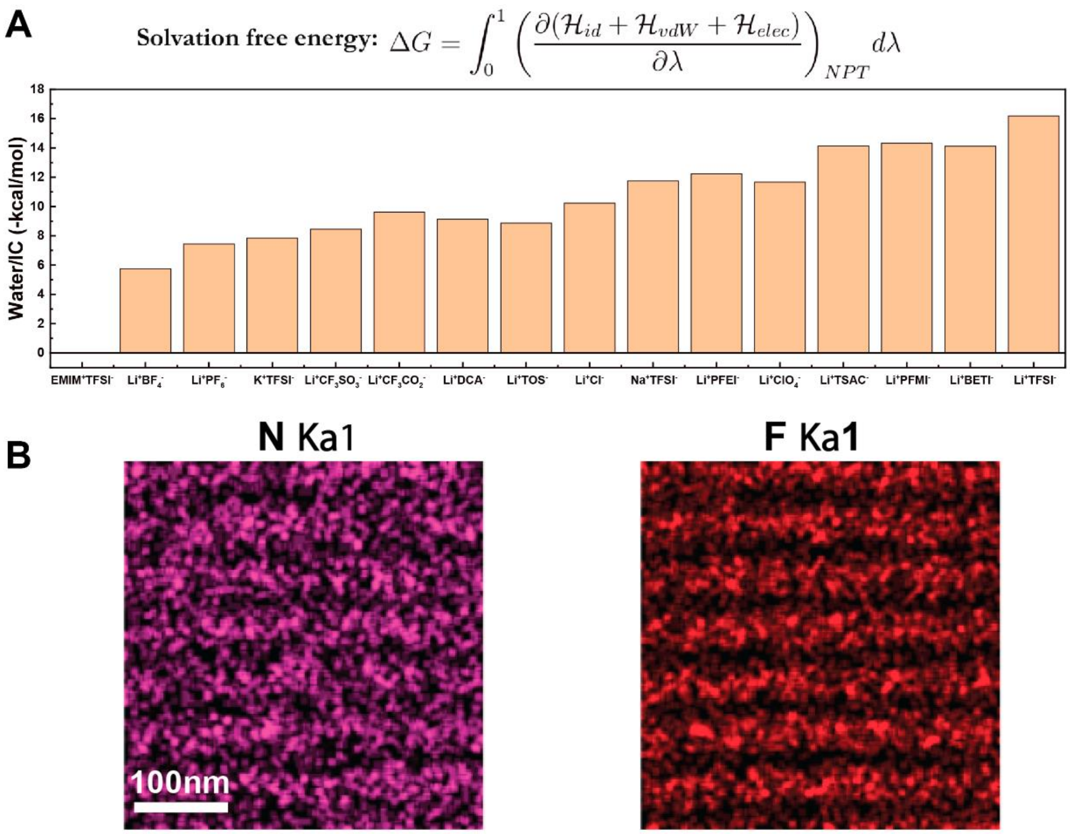


Fig. S4. Solvation properties of ionic liquid doped IHN BCP PCs. (A) Solvation free energy of various ion complexes computed by the free energy perturbation theory using molecular dynamics simulation. (B) EDX mapping images of the IHN BCP PC film with EMIMTFSI. Nitrogen (left) and fluorine (right) were monitored.

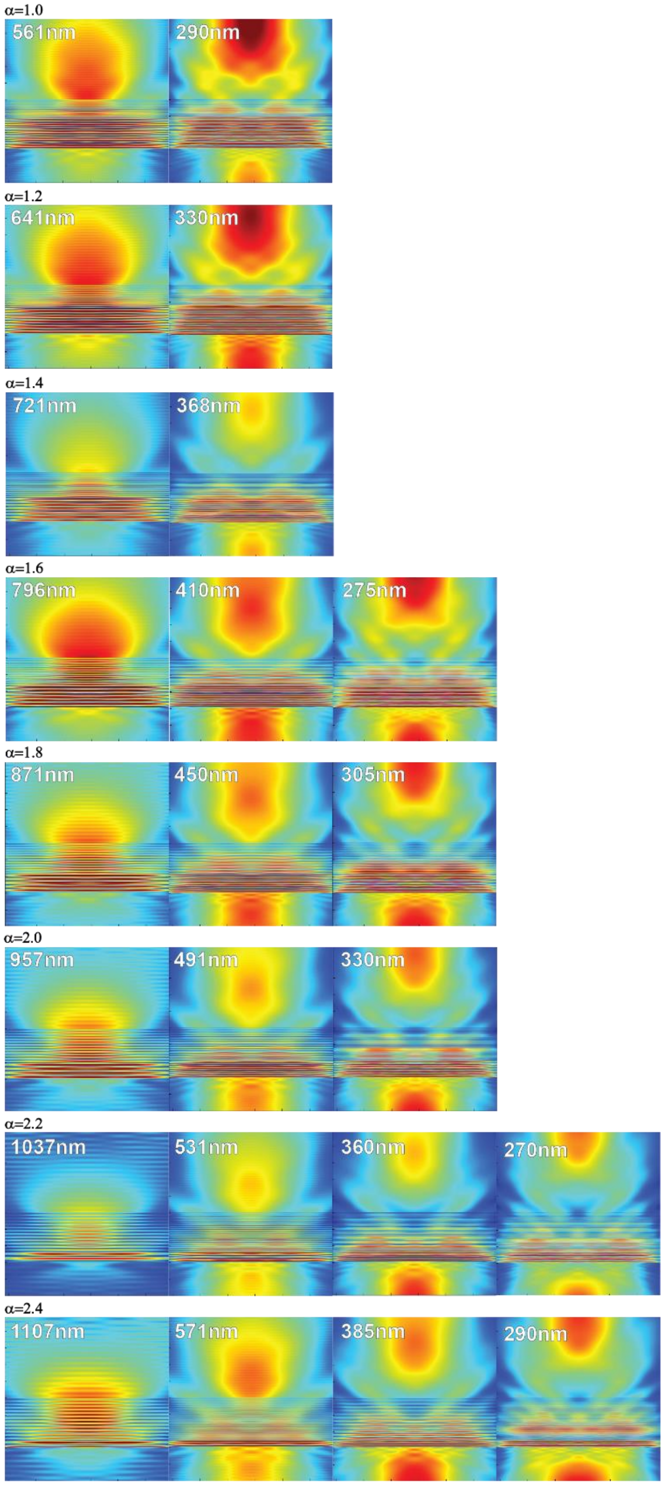


Fig. S5. FDTD simulation results of IHN BCP PCs with various swelling ratios. Modeled IHN BCP PC consists of 12 pairs of PS and IHN QP2VP layers with initial thickness of 45 and 155nm, respectively. The swelling ratio α was varied from 1.0 to 2.4.

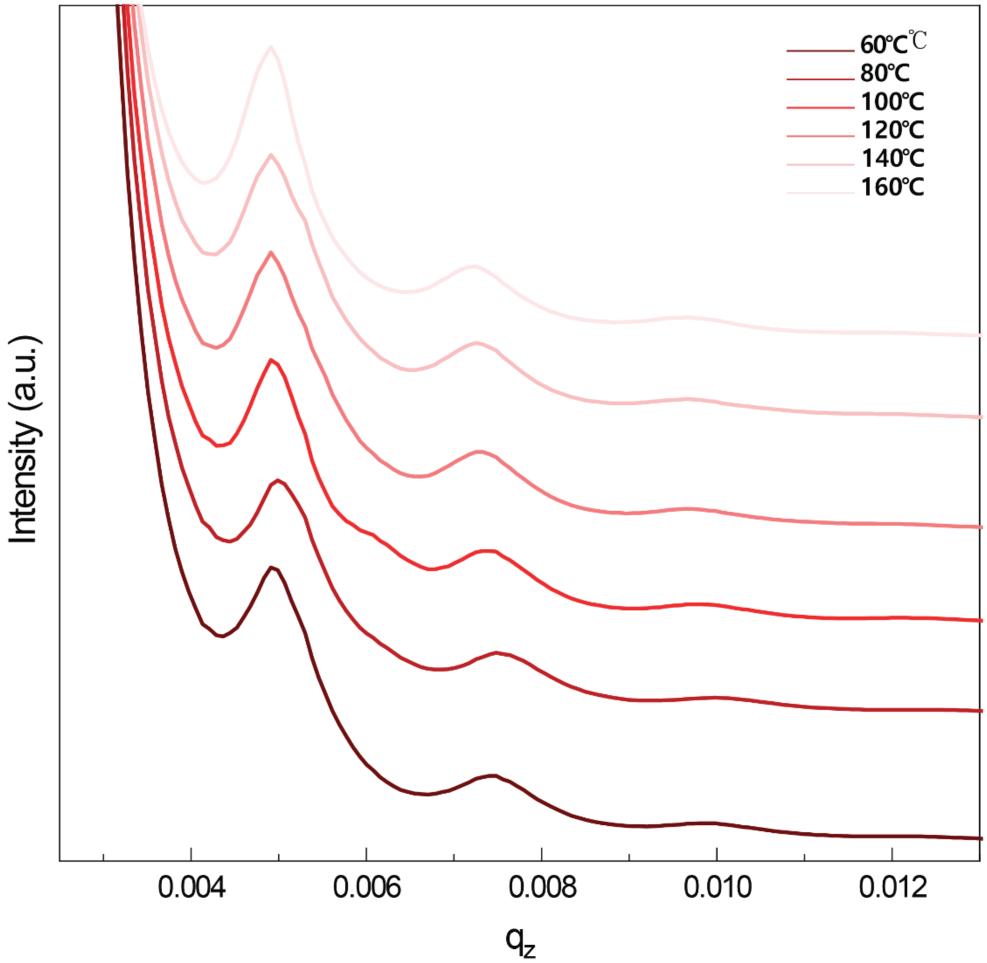


Fig. S6. Thermal stability of EMIMTFSI doped IHN BCP PC. Scattering intensity vs. q_z plots based on *in-situ* GISAXS results of an IHN BCP PC with EMIMTFSI as a function of temperature.

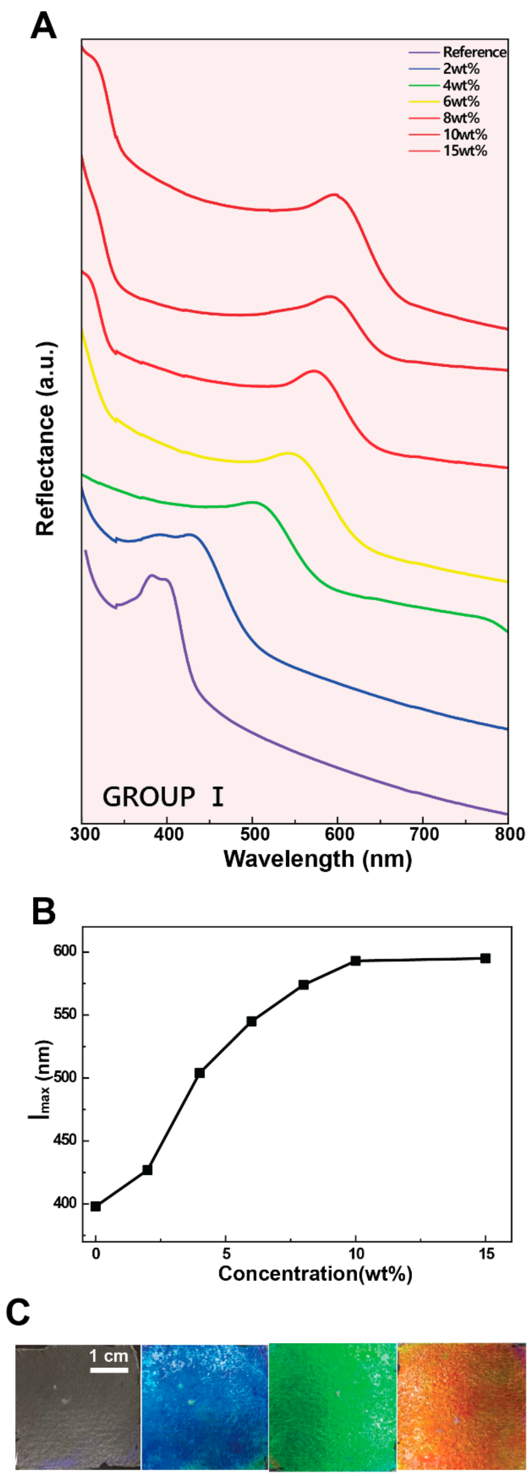


Fig. S7. Structural color variation of the EMIMTFSI doped IHN BCP PC. (A) UV-vis spectra of an IHN BCP PC film with the initial stop band at approximately 400 nm in wavelength as a function of concentration of EMIMTFSI ink. (B)) The position of stop bands of IHN BCP PC films as a function of concentration of EMIMTFSI ink. (C) Photographs of IHN BCP PCs ink-jetted with various concentration of EMIMTFSI of 0, 2, 4, and 10 %. Photo Credit: Han Sol Kang; photographer institution: Yonsei University.

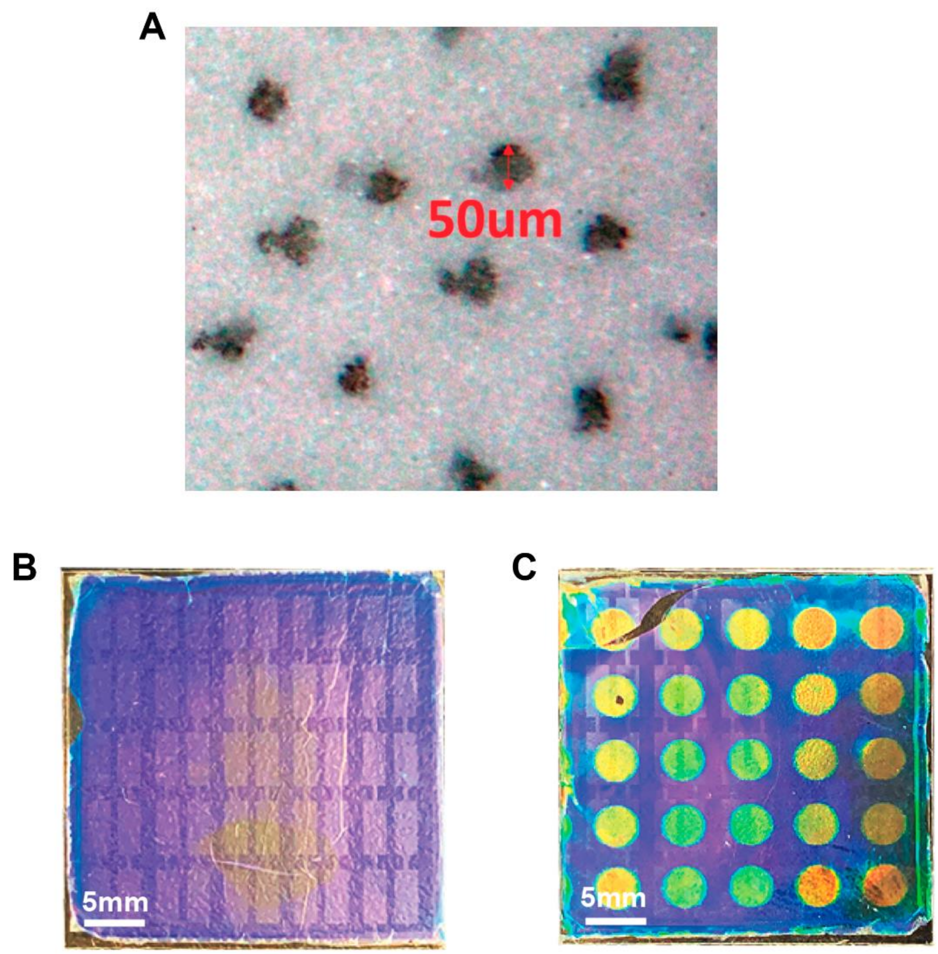


Fig. S8. Inkjet printed IHN BCP PCs. (A) Optical microscope image of individual dots on an IHN BCP PC placed on a glass substrate from a commercial black ink obtained by inkjet-printing a black & white gradient contrast map. The individual dots are approximately 50 μm in diameter. Photo images of (B) IHN BCP PC on patterned ITO array/PET substrate and (C) inkjet printed LiTFSI doped IHN BCP PC sensing displays. It should be noted that we intentionally inkjet-printed high concentration LiTFSI ink for clear visualization of the channel areas with distinct appearance of orange SC arising from instantaneous water uptake from environment. Photo Credit: Han Sol Kang; photographer institution: Yonsei University.

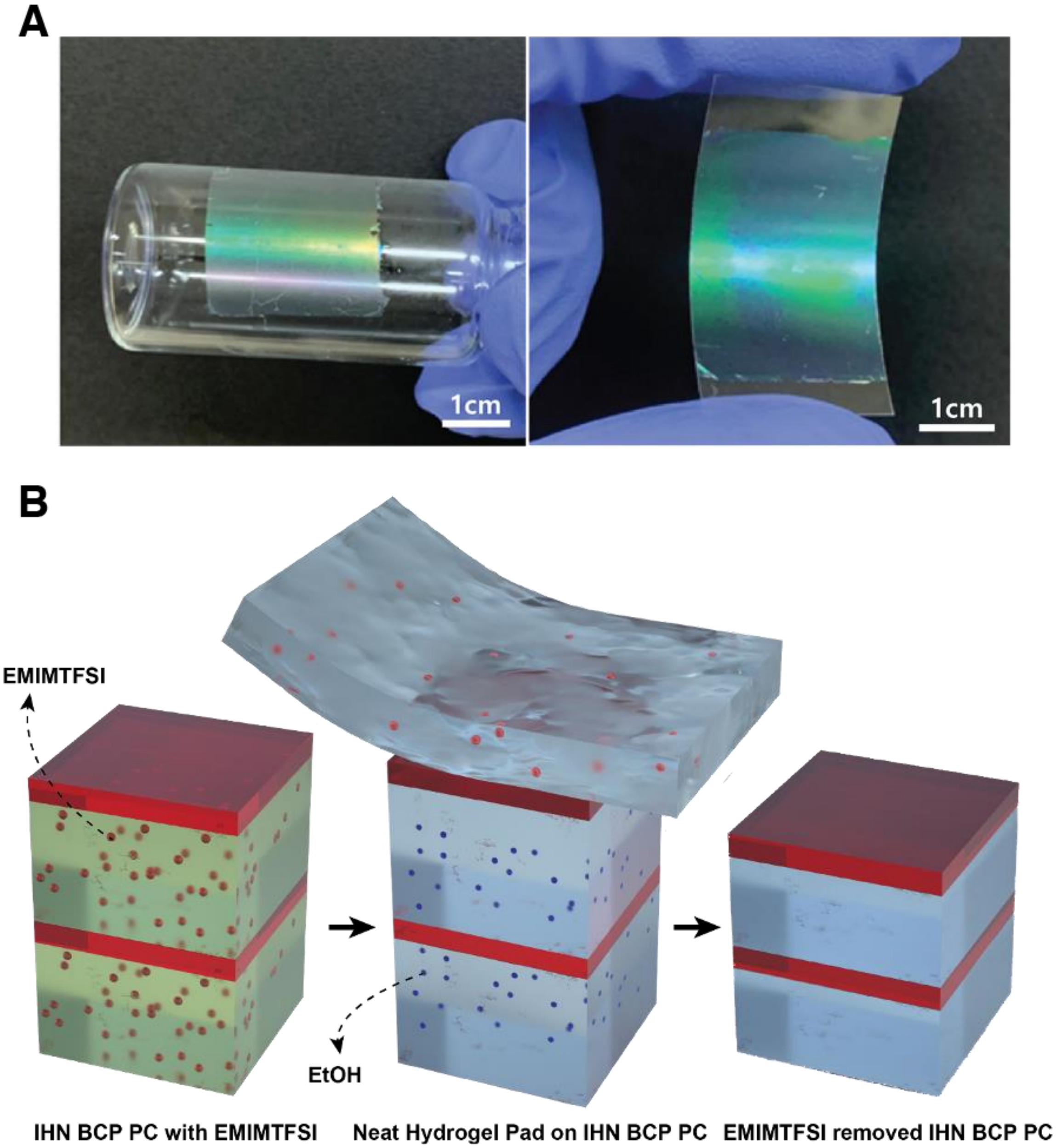


Fig. S9. Flexible and rewritable IHN BCP PCs. (A) Photographs of IHN BCP PCs transferred on glass bottle (left) and PET substrate (right). (B) Schematic illustration of the erase process of EMIMTFSI ink printed on an IHN BCP PC with a neat hydrogel pad placed on top of the IHN BCP PC. Photo Credit: Han Sol Kang; photographer institution: Yonsei University.

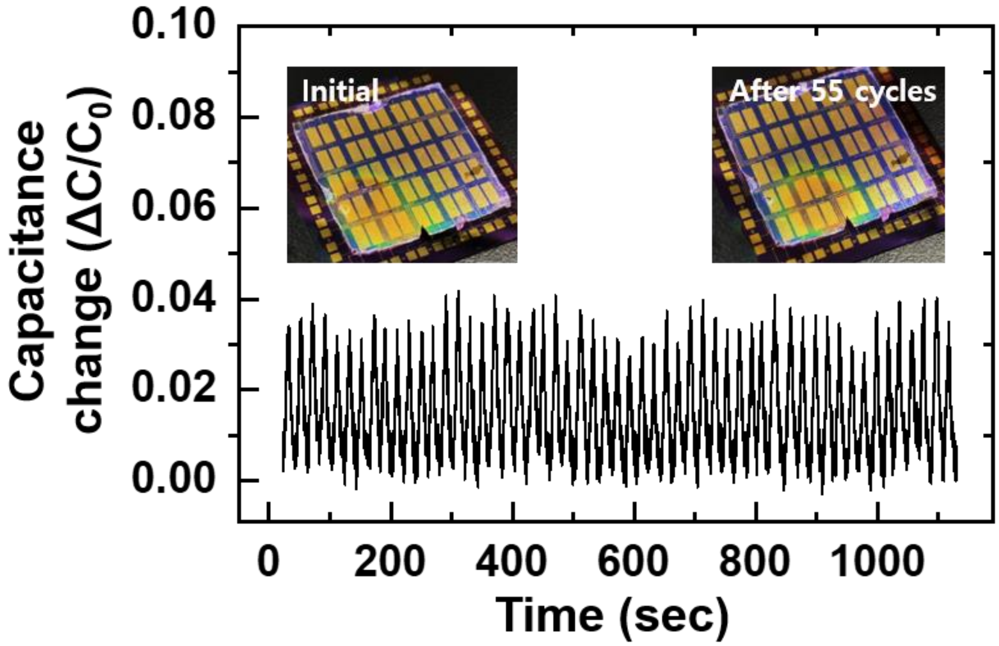


Fig. S10. Sustainability of 3D touchless BCP sensing display. Capacitance changes of 3D touchless sensing display with repetitive finer approach events to IHN BCP PC. Photo Credit: Han Sol Kang; photographer institution: Yonsei University.