**Supporting information**

# Electronic Supplementary Information (ESI) for

# Biocompatible, Flexible and Conductive Polymers Prepared by Biomass-derived Ionic Liquid Treatment

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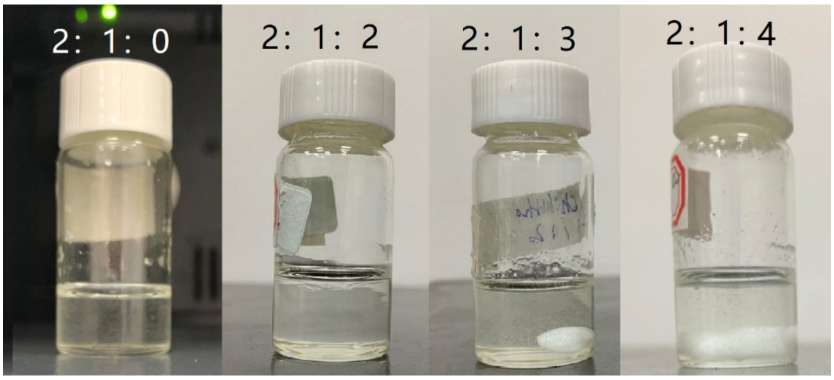


Figure S1 Image of as-synthesized [CA][ChCl]-0, [CA][ChCl]-1, [CA][ChCl]-2 and [CA][ChCl]-3 with mole ratios of [CA]:[ChCl]:[$H_2O$].

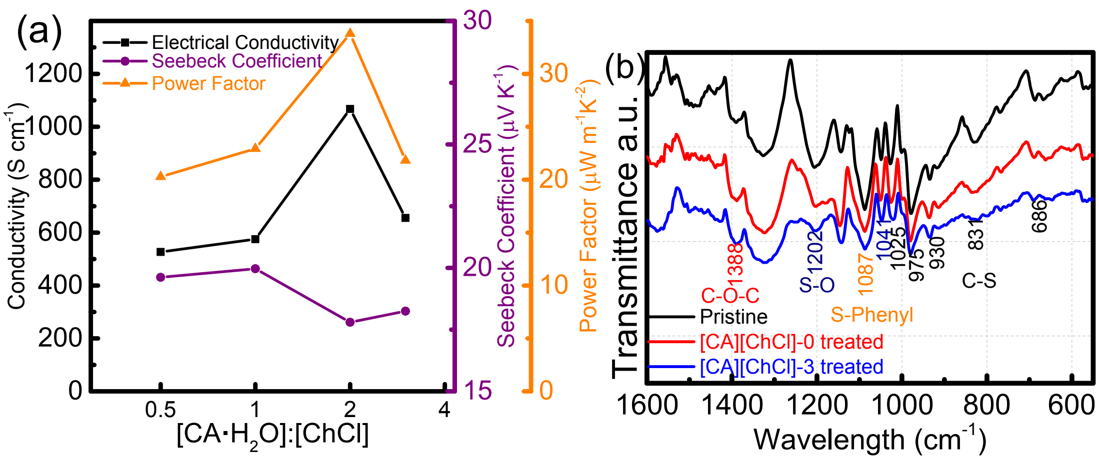


Figure S2 (a) Effect of [CA·$H_2O$]:[ChCl] ratio on thermoelectric performance of treated films at 60 °C; (b) ATR-FTIR spectra of pristine, [CA][ChCl]-0 and [CA][ChCl]-3 treated films.

To explore the effect of ratio on conductive performance, [CA·$H_2O$] [ChCl] eutectic mixtures were prepared by mixing ChCl and CA·$H_2O$ in mole ratios of 0.5:1, 1:1, 2:1 and 3:1. The optimized [CA·$H_2O$] [ChCl] mole ratio was 2:1 (Figure S2a), corresponding to an electrical conductivity of 1067 S cm$^{-1}$, Seebeck coefficient of 17.8 μV K$^{-1}$ and PF of 33.8 μW m$^{-1}$K$^{-2}$

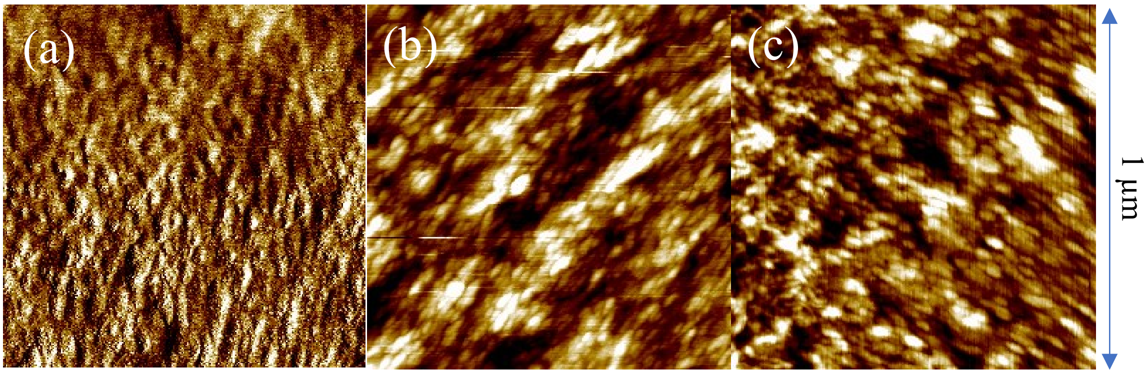


Figure S3 AFM phase images of (a) Pristine; (b) [CA][ChCl]-0 treated; (c) [CA][ChCl]-3 treated PEDOT:PSS films.

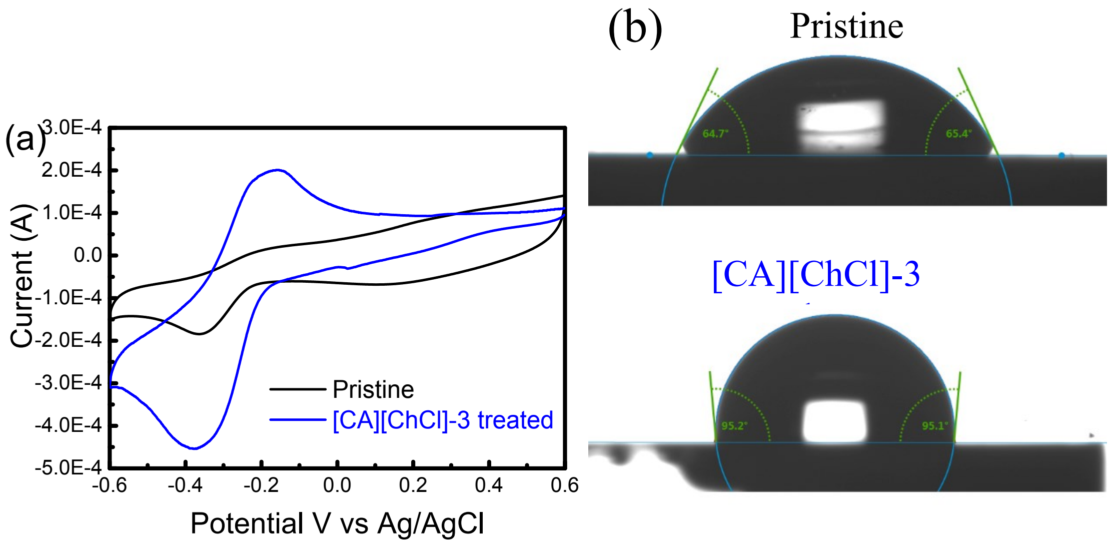


Figure S4 (a) Cyclic voltammograms of pristine and [CA][ChCl]-3 treated films at 120 °C; (b) Water contact angles (Top: Pristine; Bottom: [CA][ChCl]-3 treated PEDOT:PSS films at 120 °C. )

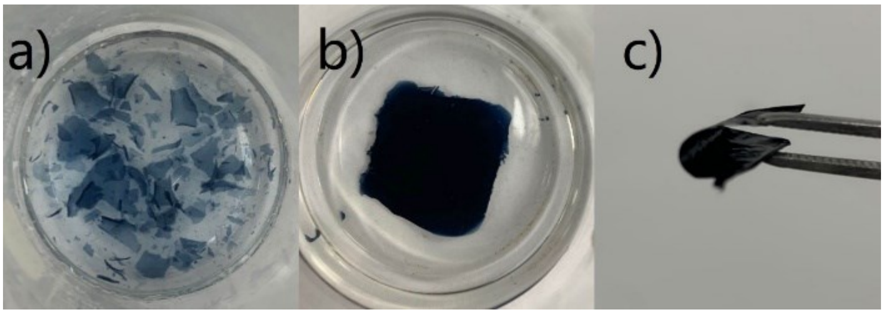


Figure S5 (a) Pristine film immersed in water at 50 °C for 10 mins; (b) [CA][ChCl]-3 treated film immersed in water at 70 °C for 5 days; (c) the image of bendable, post-treated free-standing film.

Table S1 The viscosity of as-synthesized [CA][ChCl] ionic liquids (measured at 35°C)

| | **[CA][ChCl]-0** | **[CA][ChCl]-1** | **[CA][ChCl]-2** | **[CA][ChCl]-3** |
|---|---|---|---|---|
| Viscosity (cP) | Out of range | 33000 | 4830 | 1550 |

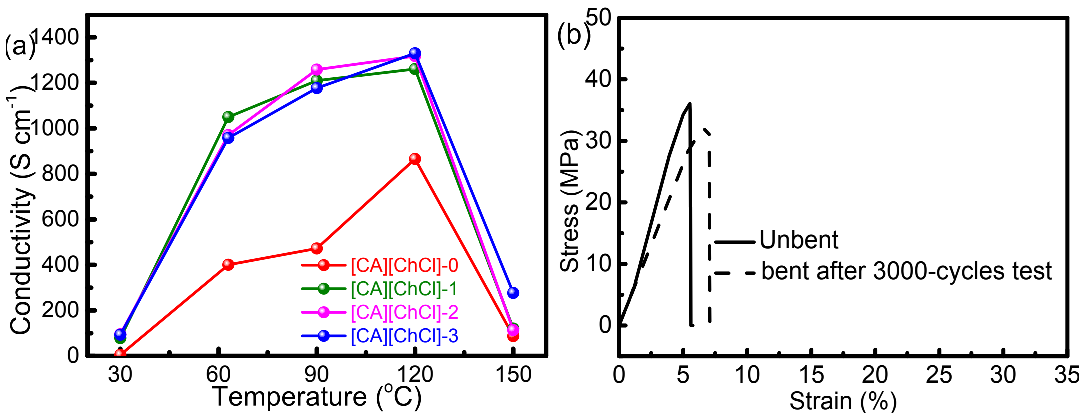


Figure S6 (a) Effect of added water content on electrical conductivity of [CA][ChCl] treated films at various temperatures; (b) Stress−strain curve of unbent and 3000-cycle-bent free-standing [CA][ChCl]-3 treated films. The thickness of the films was ≈15 μm.

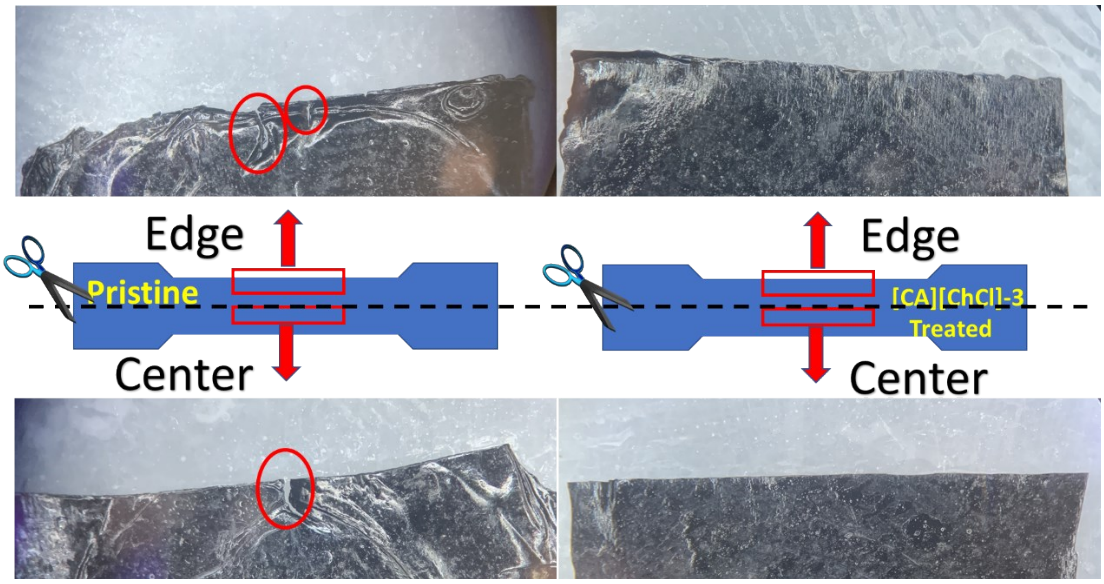


Figure S7 Optical microscopy images (20x) of free-standing pristine and [CA][ChCl]-3 treated films after bending tests.

As shown in Figure S7, short and small cracks (marked by red rings) perpendicular to the direction of bending were observed upon both the edges and in the center of pristine films after bending tests, resulting in a rapid change in resistance[1]. However, on neither the edge nor the center of [CA][ChCl]-3 treated films were noticeable changes observed, but rather wavy surfaces.

References

1. M. H. Jeong, A. Sanger, S. B. Kang, Y. S. Jung, I. S. Oh, J. W. Yoo, G. H. Kim and K. J. Choi, *Journal of Materials Chemistry A*, 2018, **6**, 15621-15629.