

Supporting information

Poly(vinylidene) Fluoride-Stabilized Black γ -phase CsPbI₃ Perovskite for High Performance Piezoelectric Nanogenerators

Weiguang Zhu,[†] Asif Abdullah Khan,[†] Md Masud Rana,[†] Rozenn Gautheron-Bernard,[‡] Nicolas R. Tanguy,[‡] Ning Yan,[‡] Pascal Turban,[‡] Soraya Ababou-Girard[‡] and Dayan Ban^{*,†,‡,§}

[†] Waterloo Institute for Nanotechnology, University of Waterloo, Waterloo N2L 3G1, ON, Canada

[‡] Department of Electrical and Computer Engineering, University of Waterloo, Waterloo N2L 3G1, ON, Canada

[§] School of Physics and Electronics, Henan University, Kaifeng 475001, Henan, P. R. China

[‡] Univ Rennes, CNRS, IPR (Institut de Physique de Rennes) - UMR 6251, F-35000 Rennes, France

[‡] Department of Chemical Engineering and Applied Chemistry, University of Toronto, Toronto, ON M5S 3E5, Canada

*Email: dban@uwaterloo.ca.

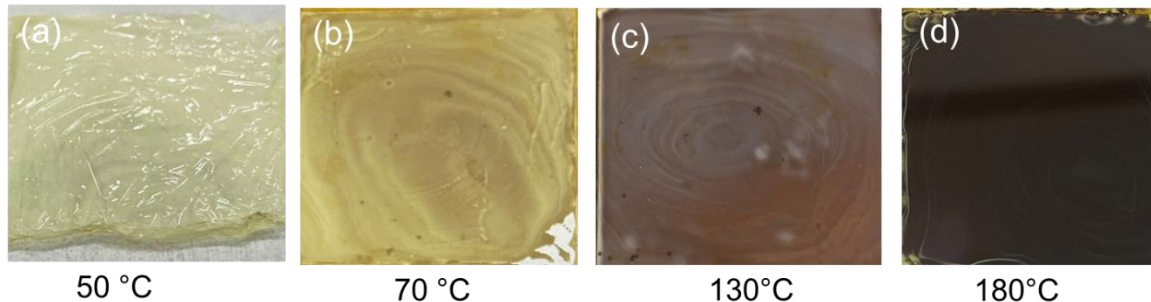


Figure S1. Optical images of CsPbI₃@PVDF composite films obtained at different temperature (a) 50 °C, (b) 70 °C, (c) 130 °C and (d) 180 °C.

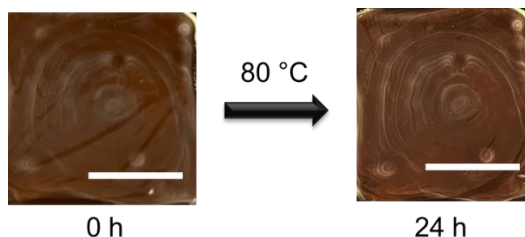


Figure S2. Optical images of black CsPbI₃@PVDF composite film heating at 80 °C under ambient condition for 24 h, displaying good thermal stability.

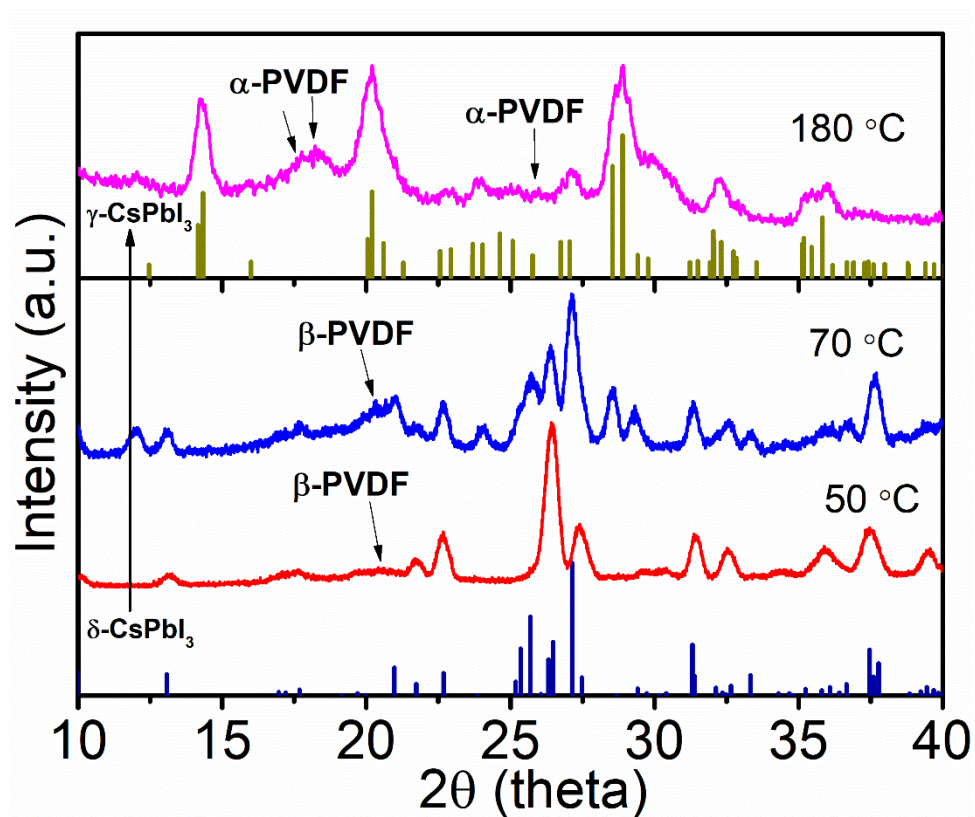


Figure S3. XRD patterns of CsPbI₃/PVDF prepared at different temperature, 50 °C, 70 °C and 180 °C, respectively.

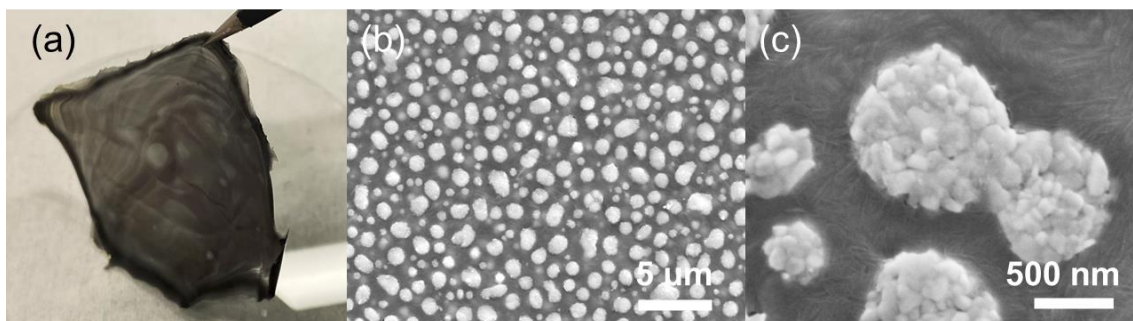


Figure S4. Optical image (a) and SEM images (b and c) of black 30wt% CsPbI₃ @PVDF composite.

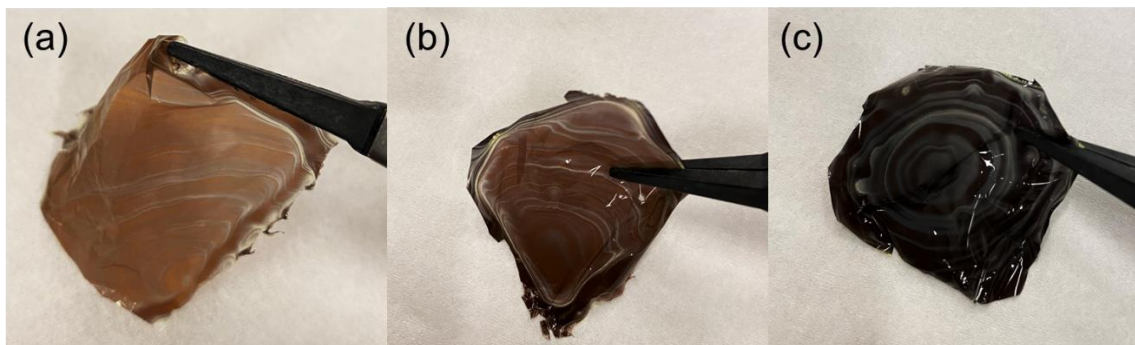


Figure S5. Optical images of black CsPbI₃@PVDF composite with (a) 10 wt%, (b) 20 wt%, and (c) 30 wt% of CsPbI₃, stored at ambient condition for over 6 months.

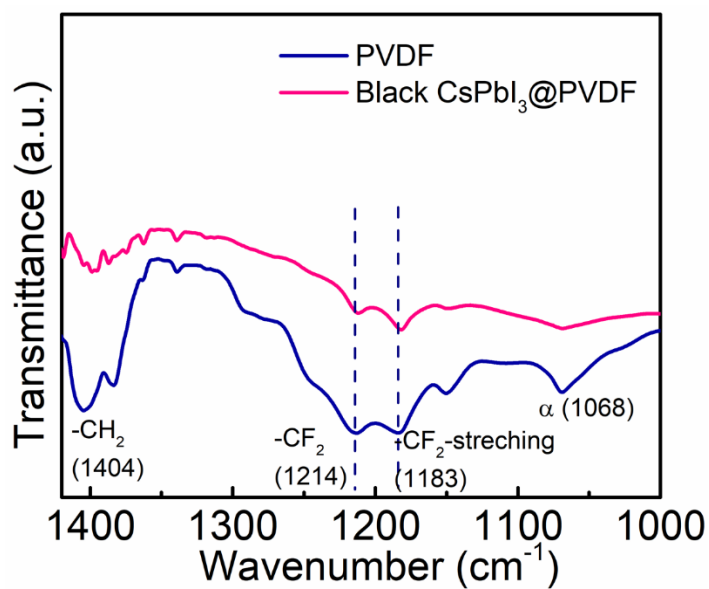


Figure S6. FTIR spectra of pure PVDF and the black CsPbI₃@PVDF composite film.

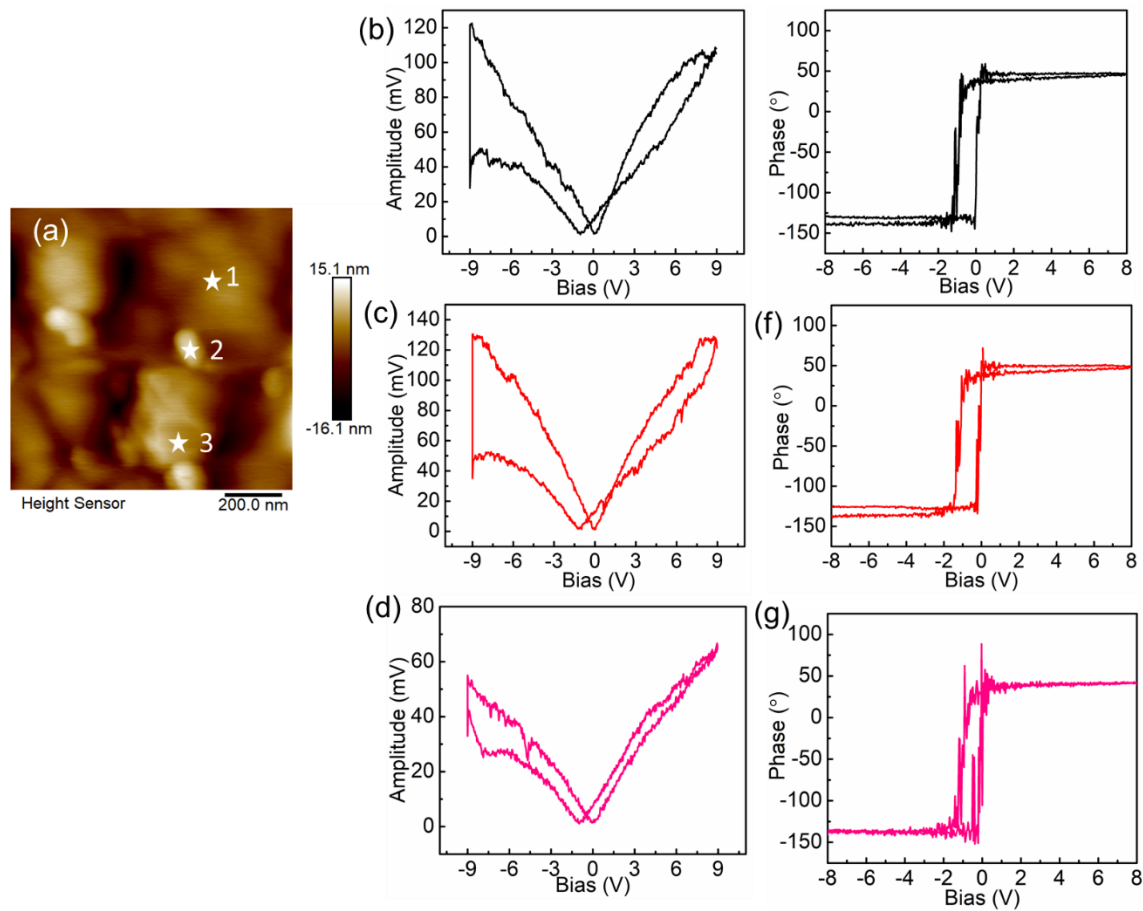


Figure S7. (a) Topography image of the black CsPbI₃/PVDF composite; Amplitude loops (b-d) and phase hysteresis loops (e-g) were obtained at spot 1, spot 2 and spot 3, respectively, as indicated in Figure S6a.

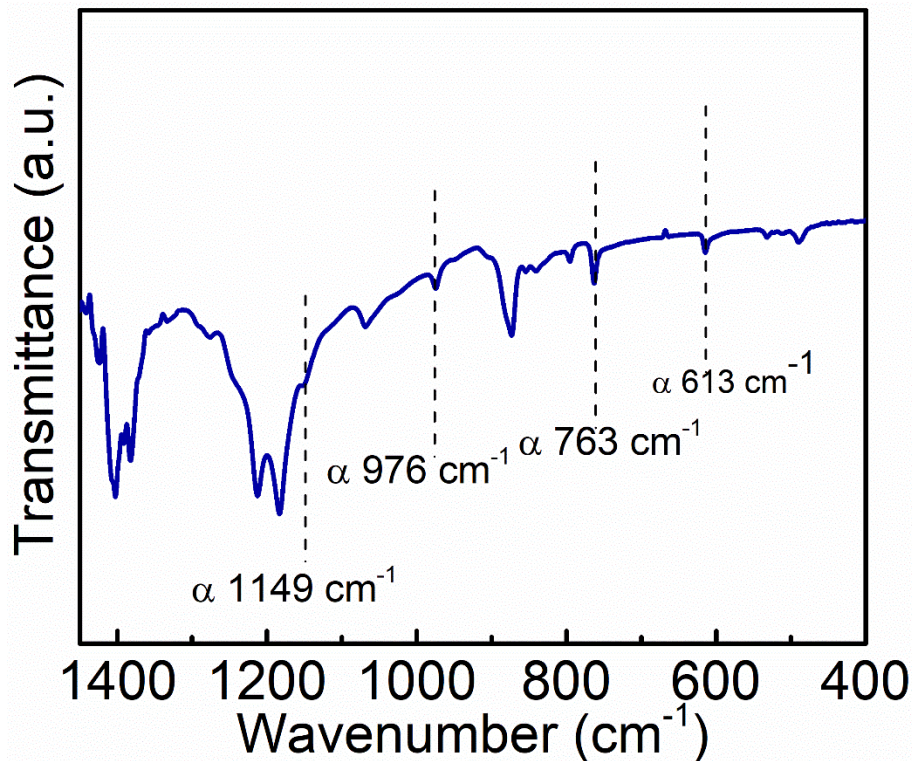


Figure S8. FTIR spectrum of the black CsPbI₃/PVDF composite thin film, prepared at 180°C.

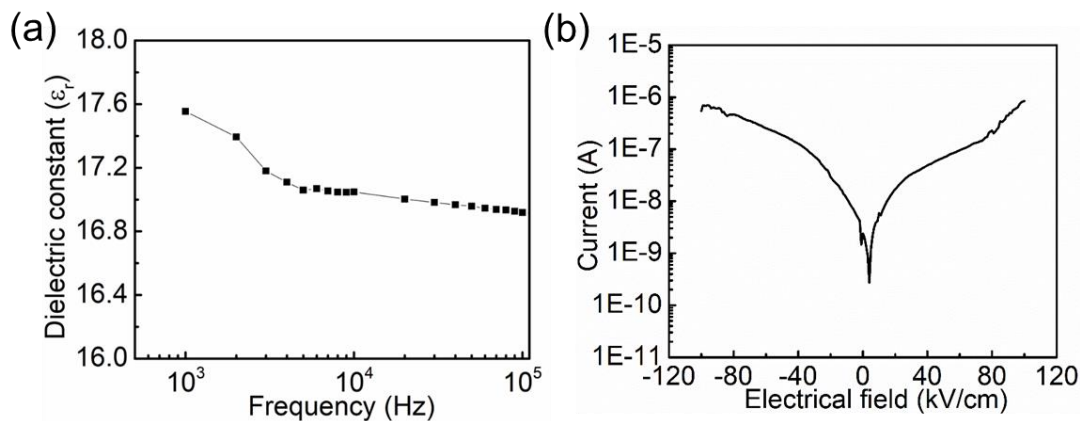


Figure S9. (a) Dielectric constant as a function of frequency for the black CsPbI₃/PVDF composite film. (b) Leakage current curve of black CsPbI₃/PVDF composite under an electrical field of ± 100 kV/cm.

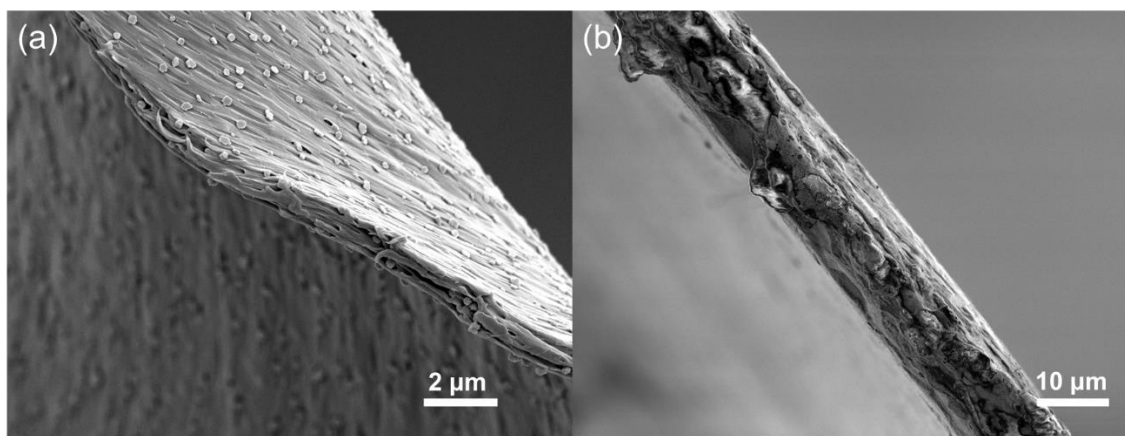


Figure S10. A SEM images of (a) 1-layer CsPbI₃@PVDF thin film on the cross-section, displaying a thickness $\sim 1\ \mu\text{m}$, and (b) the cross section of 5-layer CsPbI₃@PVDF composite film.

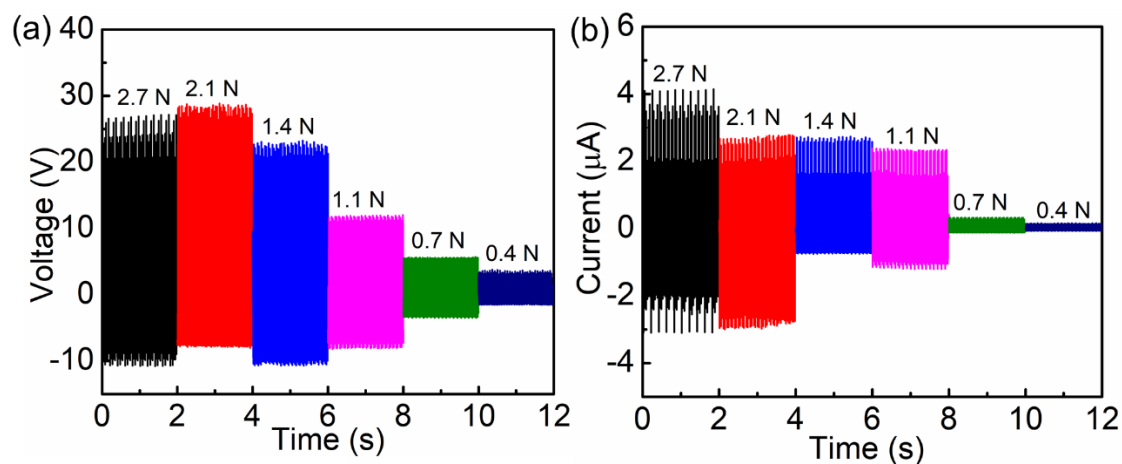


Figure S11. (a) Output voltage and (b) output current characteristics with different applied force.