

ADVANCED FUNCTIONAL MATERIALS

Supporting Information

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Highly Conductive n-Type Polymer Fibers from the Wet-Spinning of n-Doped PBDF and Their Application in Thermoelectric Textiles

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1. Fiber cross sections

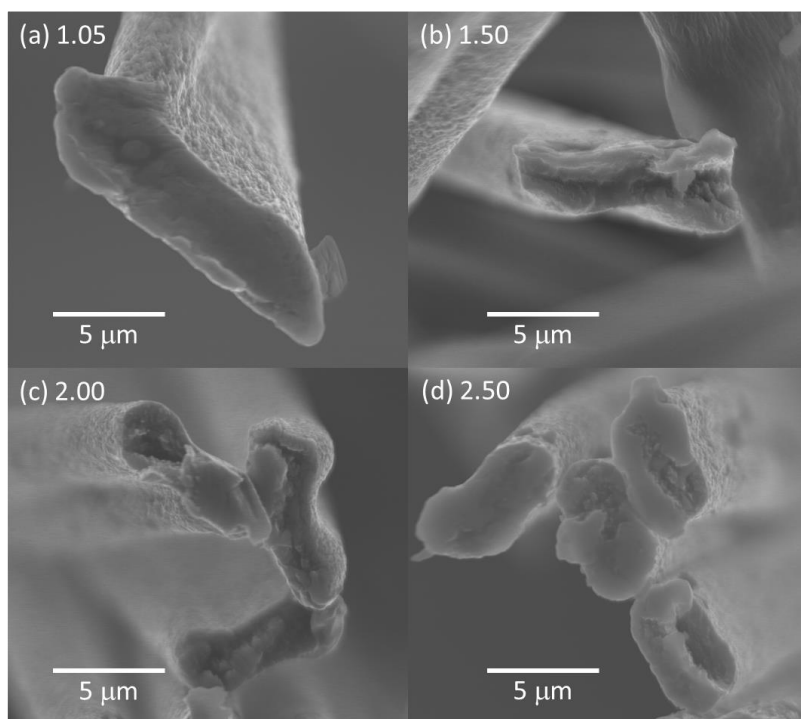


Figure S1. a-d) SEM images showing the cross sections of PBDF fibers with total draw of (a) 1.05, (b) 1.50, (c) 2.00, and (d) 2.50.

2. Linear density prediction from mass balance

The linear density, LD, of the fibers can be predicted by applying a mass balance to the wet-spinning system with respect to PBDF. In other words, the mass flow of PBDF entering the coagulation bath, $M_{\text{PBDF,coag}}$, through the capillary spinneret should be equal to the mass flow of PBDF being collected as fiber, $M_{\text{PBDF,fiber}}$. This assumes that all PBDF is coagulating and none is being lost to the coagulation bath. $M_{\text{PBDF,coag}}$ and $M_{\text{PBDF,fiber}}$ can be expressed as:

$$M_{\text{PBDF,coag}} = Q \cdot \rho_{\text{solution}} \cdot C_{\text{PBDF,solution}} \quad (\text{S1})$$

$$M_{\text{PBDF,fiber}} = LD \cdot v_{\text{roller}} \quad (\text{S2})$$

where Q is the flow rate (constant at 0.25 mL h^{-1} in this work), ρ_{solution} is the density of the PBDF:DMSO solution (assumed to be equal to the density of DMSO, 1.1 g cm^{-3}), $C_{\text{PBDF,solution}}$ is the concentration of PBDF in the PBDF:DMSO solution ($\sim 0.85 \text{ wt.}\%$ in this work), and v_{roller} is the linear speed of the rotating roller collecting the fibers.

Since Q is equal to the linear speed of the extruded solution, v_{solution} , multiplied by the area of the spinneret, $A_{\text{spinneret}}$, and the total draw, DR_{Total} , is equal to the ratio $v_{\text{roller}}/v_{\text{solution}}$, the following expression for linear density as a function of DR_{Total} can be derived from Equation S1 and S2.

$$LD = A_{\text{spinneret}} \cdot \rho_{\text{solution}} \cdot C_{\text{PBDF,solution}} / DR_{\text{Total}} \quad (\text{S3})$$

Equation S3 was used to calculate the estimated linear density curve that is plotted in **Figure 1b**.

3. Lorentz fitting of 2D WAXS integrated patterns

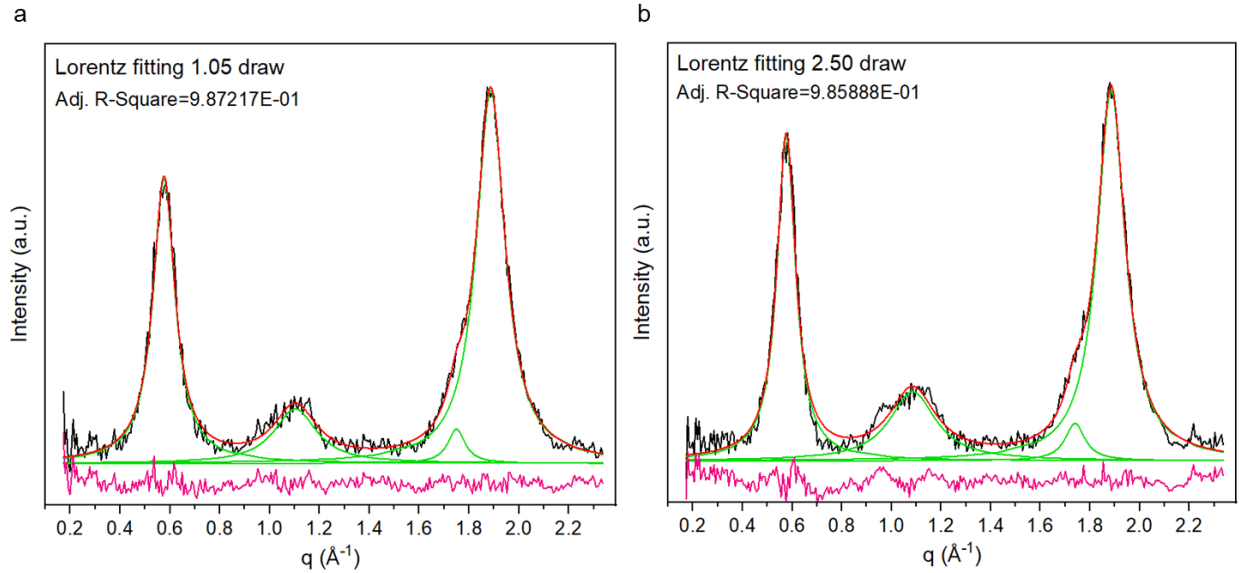


Figure S2. Lorentz fitting of the 2D WAXS total integrated intensity of PBDF fibers fabricated with total draws of (a) 1.05 and (b) 2.50.

4. Table S1. Summary of electrical conductivity, Seebeck coefficient, and power factor of n-type polymeric materials.

Polymer	$\sigma_{\max}$ (S cm ⁻¹)	S at max PF ($\mu\text{V K}^{-1}$)	PF _{max} ($\mu\text{W m}^{-1} \text{K}^{-2}$)	Reference
P(NDIOD-T2)	0.008	-850	0.6	[1]
PNDI2TEG-2Tz	1.8	-159	4.6	[2]
FBDPPV	14.0	-200	28.0	[3]
UFBDPPV	22.5	-400	80.0	[4]
PFCITVT	38.3	-800	39.5	[5]
pNB-TzDP	11.6	-215	53.4	[6]
P(PzDPP-CT2)	8.4	-380	57.3	[7]
LPPV-1	1.1	-133	1.96	[8]
Poly (Ni-ett)	227	-126	360	[9]
BBL:PEI	8	-150	11	[10]
TBDOPV-T-518	114	-175	200	[11]
PBDF	2000	-21.0	90	[12]
PBDF	6000	-	-	[13]
PBDF	1600	-33.0	91	This work

5. Ampacity

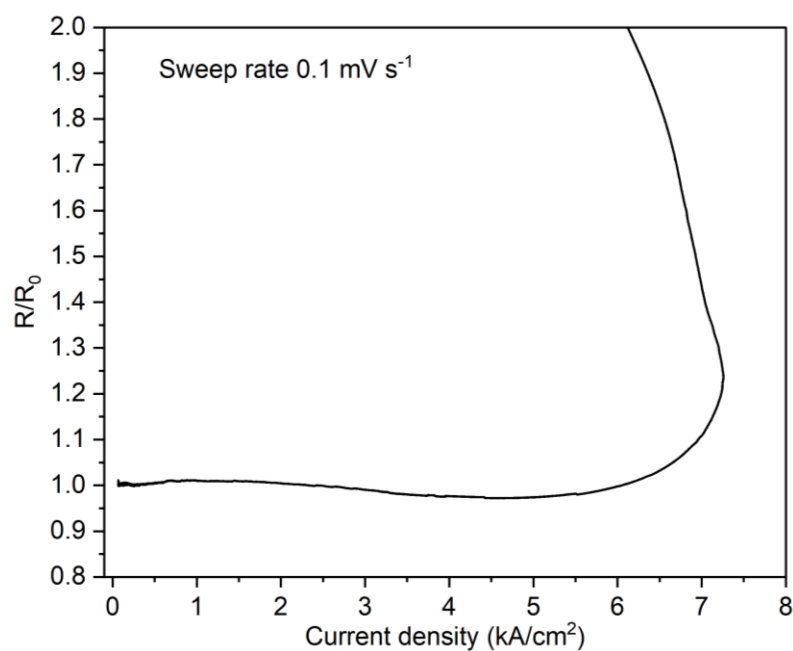


Figure S3. Change in the resistance (normalized to the initial resistance) of a PBDF fiber versus the current density. For this test, the fiber was laid between two copper strips, contacted using silver paint and the voltage was swept at 0.1 mV s^{-1} while recording the current.

6. OECT time-of-flight mobility

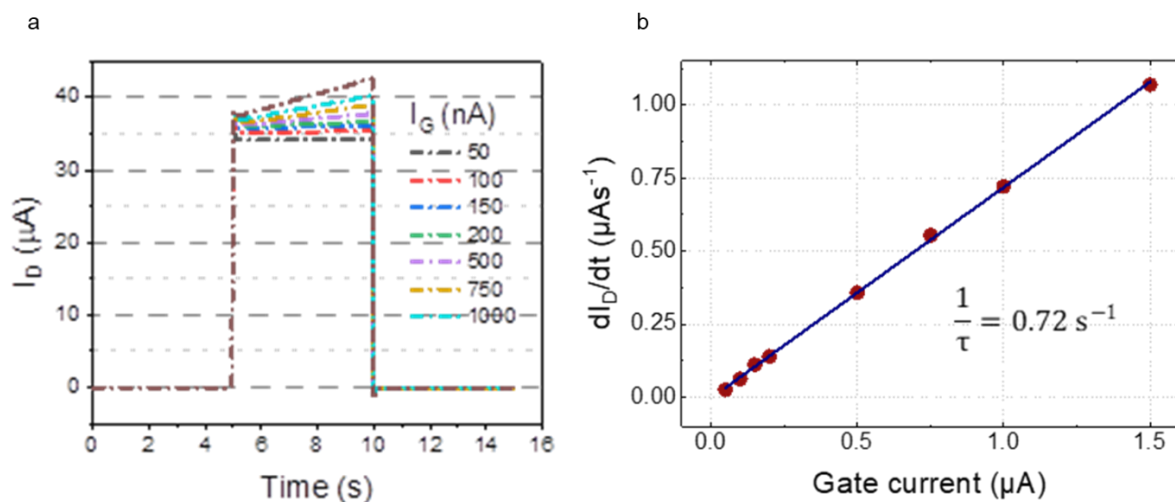


Figure S4. Transient analysis of a representative PBDF fiber-OECT. (a) Transient response. (b) Transient slope of source-drain current versus gate current, used to determine the electronic transient time and subsequently the mobility of the OECT.

7. Resistance vs. Length

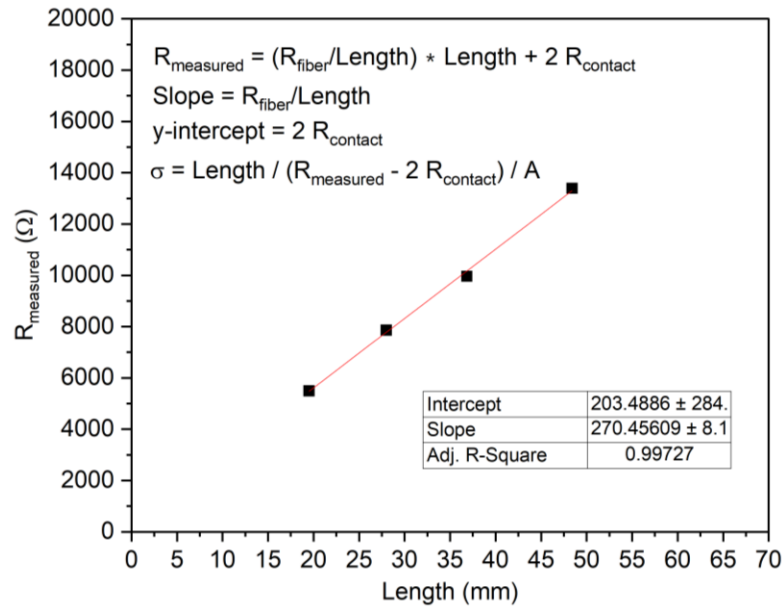


Figure S5. Example of resistance versus length plot showing the calculation of resistance per length, contact resistance, and electrical conductivity. A is the cross-sectional area of the fiber that is determined by SEM imaging.

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