Supplementary Materials for

Graphene-based implantable neural electrodes for insect flight control

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The PDF file includes:

Other Supplementary Material for this manuscript includes the following:
Movie S1 (.mp4 format). Electrically stimulated insect flight

FTIR and Raman characterization of PGF electrodes

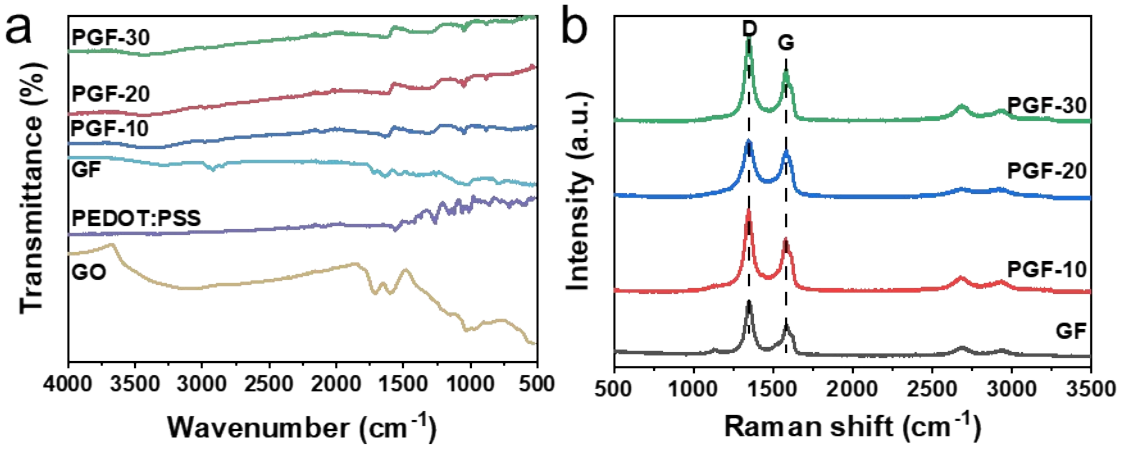

Figure S1. The (a) FTIR and (b) Raman spectra of the PEDOT:PSS, GO and PGF, respectively.

SEM images of silver wire, gold wire and PGF electrodes.

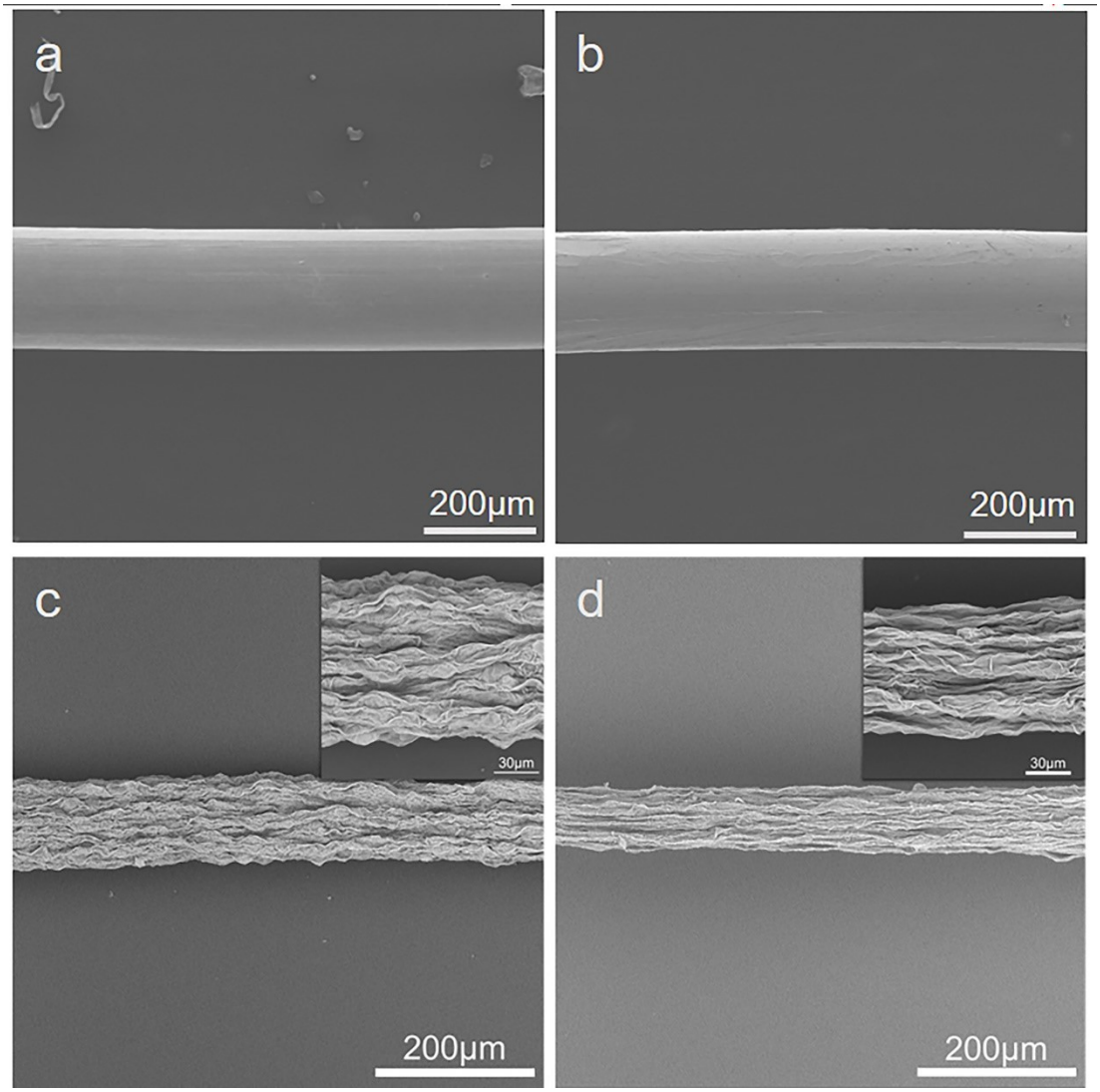

Figure S2. (a-d) SEM images of silver wire, gold wire, PGF-10 and PGF-30, respectively. The scale bar is 200 μm, the insect with a scale bar of 30 μm.

Calculation procedure of CSC and GSA

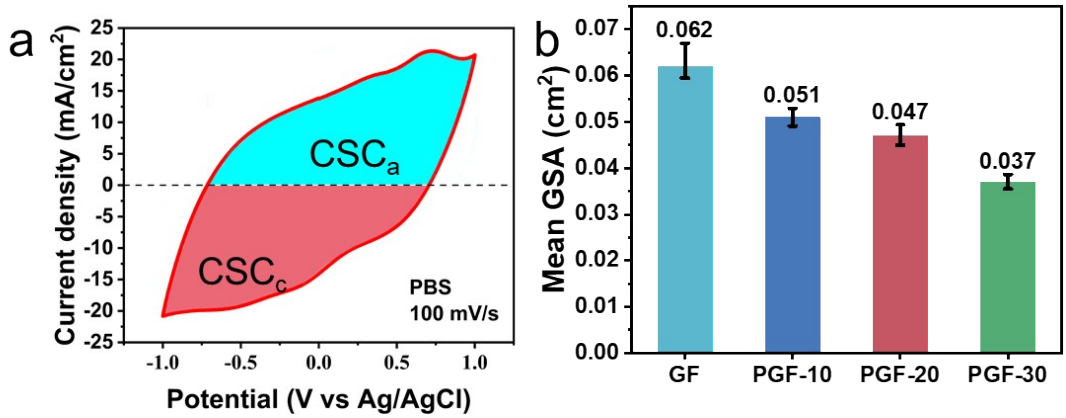

Figure S3. (a) An example of cyclic voltammetry (CV) with 100 mV/s scan rate and denoted cathodal and anodal charge storage capacity calculation. (b) The mean GSA of the GF, PGF-10, PGF-20, PGF-30, respectively.

Note S1. The calculation procedure for CSC of electrode

$$CSC = \frac{Q_a + Q_C}{GSA \cdot k} \tag{1}$$

$$GSA = \left(\frac{\pi D}{2}\right)^2 + \pi D l \tag{2}$$

$$Q_a = \int_0^{V_2} I(v)\,dv \tag{3}$$

$$Q_C = \left| \int_{V_1}^{0} I(v)\,dv \right| \tag{4}$$

where Q_a and Q_c are the charge storage capacity of the electrode's anode and cathode in mC, respectively, k is the scan rate in V/s, GSA is the cross-sectional area of the electrode in cm^2, V_1 and V_2 are the lower and upper limits of the hydration windows of the electrochemical test in V, respectively, the D represents diameter of fiber, the l represents the length of immersion in PBS, in this work, the l equals 1.5 cm.

Stability testing of silver wire, gold wire and PGF electrodes

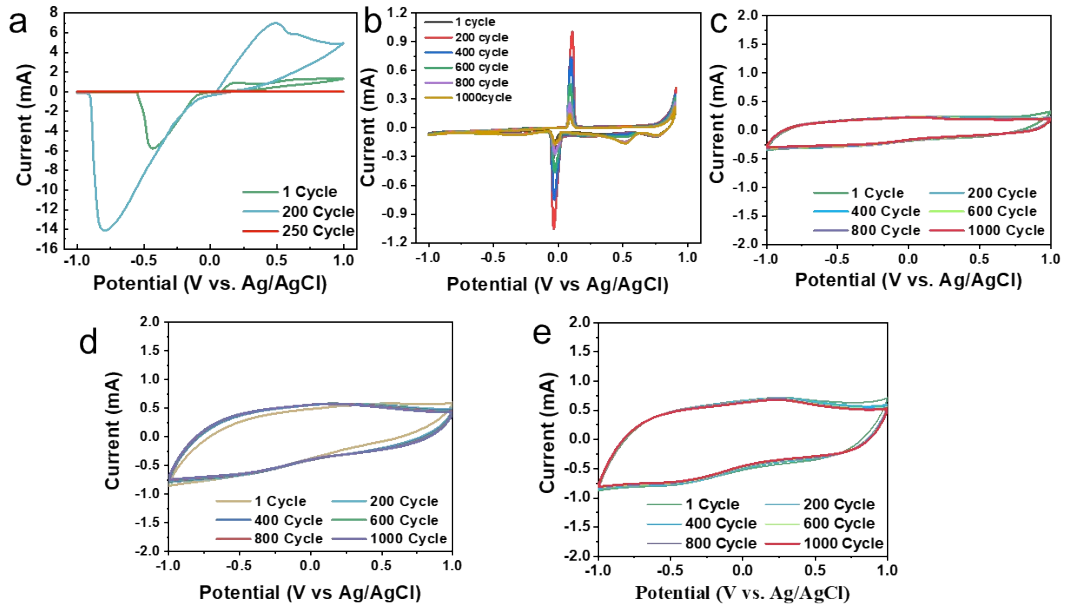

Figure S4. Long-term CV tests of the (a) silver wire, (b) gold wire, (c) GF, (d) PGF-10 and (e) PGF-30.

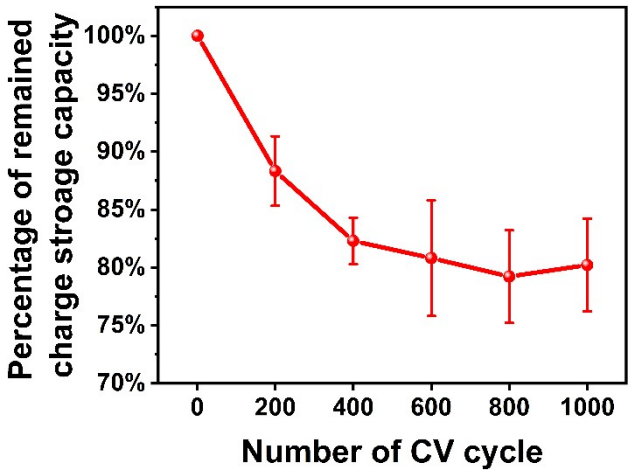

Figure S5. CSC of PGF-20 after 1000-cycle CV tests.