Electrochromic/Supercapacitive Dual Functional Fibres

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Electronic Supplementary Information

Calculation of electrode surface area: The surface area of electrode can be calculated by substracting the area of gaps (i.e., the area of strips removed from substrate) from the surface area of fibre substrate. The latter was calculated by the following equation where the substrate is considered as a cylinder:

$$A = 2\pi rH$$

where r is the radius of fibre substrate and H is the length of the substrate.

Mass calculation of electrodeposited PEDOT: According to Faraday's law, the total mass of PEDOT deposited onto fibre substrate can be calculated as follows:[1]

$$m = \frac{QM}{zF}$$

where Q is the charge (C) passed through within the system during electrodeposition process, M is the molar mass of material(i.e., 140.13 for PEDOT), z is referred to as the amount of electron transferred each unit material (i.e., 2.3 for PEDOT) and F is Faraday's constant(i.e, 96485 C/mol).

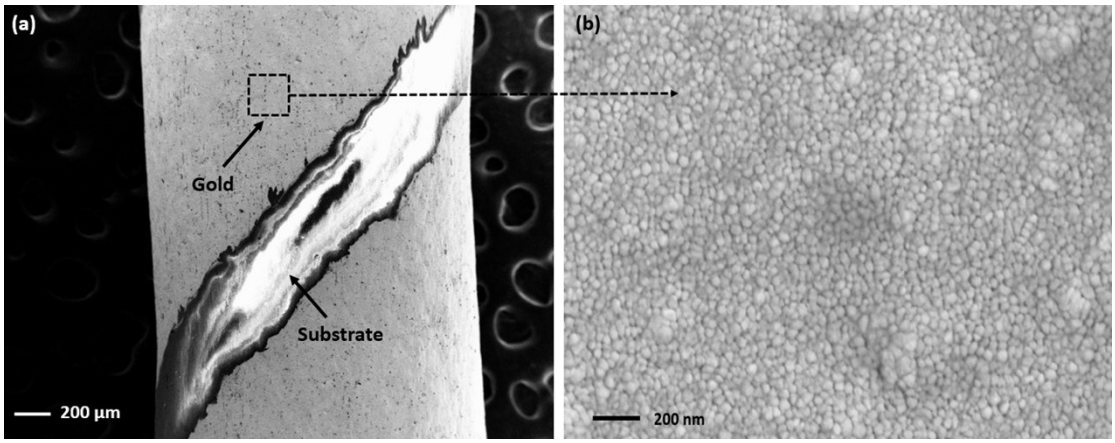

Figure S1. SEM image of (a) surface morphology of gold coated fibre substrate; (b) enlarged view of gold coated area.

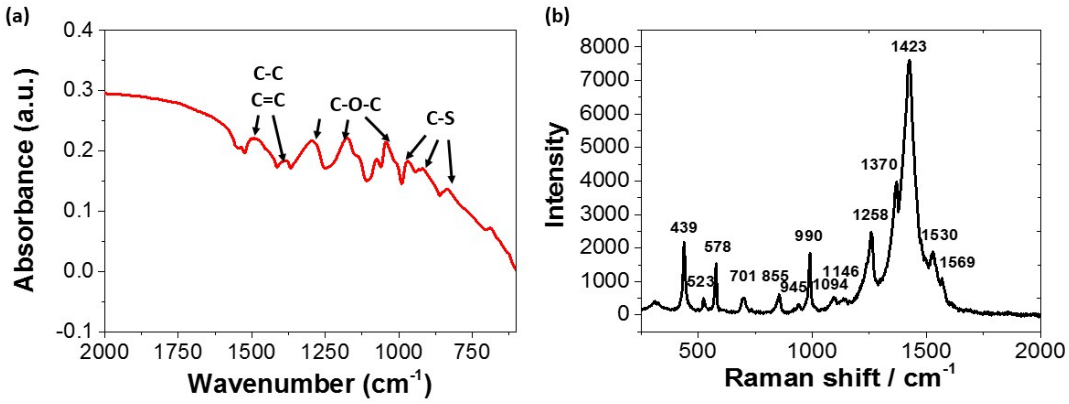

Figure S2. (a)ATR-FTIR spectrum of PEDOT coated electrode; (b) Raman spectrum of PEDOT coated electrode.

The peaks around 830 and 930 cm^{-1} can be assigned to the vibrations of C-S bonds in PEDOT structure. The peaks at 1100 and 1160 cm^{-1} are considered as the stretching of the C-O-C bonds in ethylene dioxy groups. The peaks appeared near 1300, 1400 and 1500 cm^{-1}can be attributed to the stretching of the thiophene ring. The Raman spectrum of PEDOT electrode agrees well with results presented elsewhere.[2]

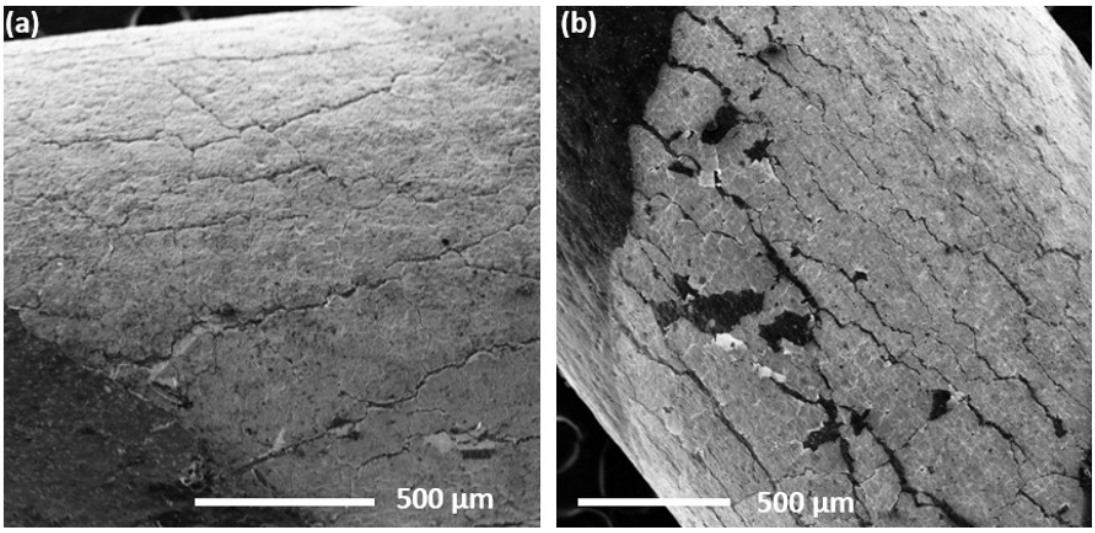

Figure S3. SEM image of surface morphology of dual functional fibre substrate (a) before cyclic voltammetry scan; (b) after 1000 cyclic voltammetry scans from -1 to +1 V.

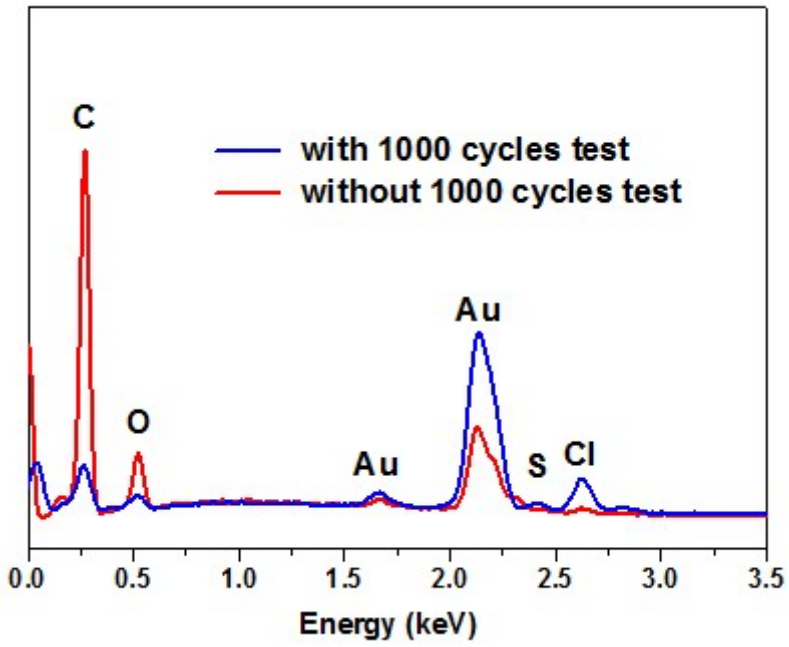

Figure S4. SEM-EDX spectrums of dual-functional fibre with and without 1000 cycles potential stimuli at 1 V.

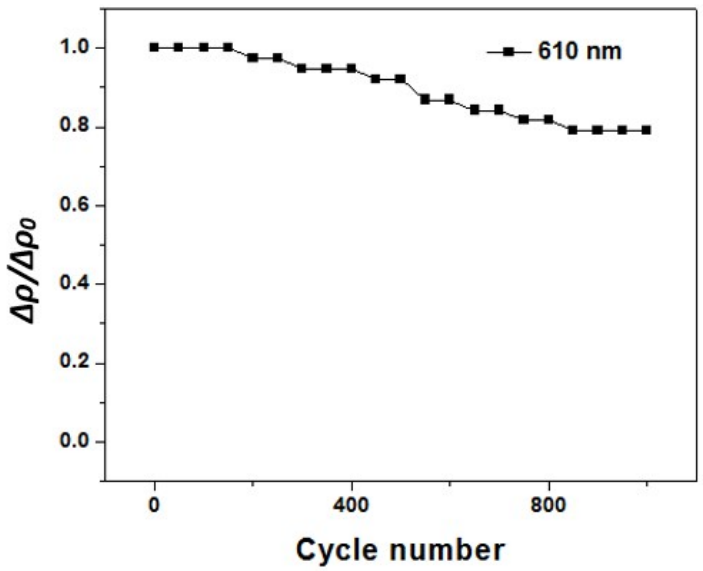

Figure S5. Loss of reflectance difference of fibre-based dual functional devices under galvanostic charge-discharge test.

COMSOL MultiPhysics® Calculation:

Model chosen: Electric current (EC) physical interface of AC/DC model is used for potential distribution of as-prepared device under stationary study mode.

Dimensions (W x D x H): Gold coated counter electrode: 1 x 10 x 0.1 mm

PEDOT coated working electrode: 15 x 10 x 0.1 mm

Gap between two electrodes: 1 x 10 x 0.1 mm

Gel electrolyte: 17 x 10 x 5 mm (Model I); 19 x 10 x 5 mm (Model II)

Materials:

Electrical conductivity(S/m): 45.6 x 10^{-6} (Gold); 0.05 (PEDOT); 0.2 (Electrolyte)

Relative permittivity: -1300 (Gold); 250 (PEDOT); 64.6 (Electrolyte)

Potential applied: 0.6 V (Gold counter electrode(s)); 0 V (PEDOT coated working electrode(s))

Reference:

1. J. Duay, E. Gillette, R. Liu and S. B. Lee, *Phys. Chem. Chem. Phys.*, 2012, **14**, 3329-3337.
2. S. Sakamoto, M. Okumura, Z. G. Zhao and Y. Furukawa, *Chem. Phys. Lett.*, 2005, **412**, 395-398.