Electronic Supplementary Information

Towards biodegradable conducting polymer by incorporating seaweed cellulose for decomposable wearable heater

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Experimental Section

Chemical and Materials: PEDOT:PSS aqueous solution (Clevios PH1000) was purchased from Heraeus (Germany) and filtered using a 0.45 µm filter. Seaweed cellulose was supplied by Scion (New Zealand) and glycerol (G7757, CAS 56-81-5) was purchased from Sigma-Aldrich. The PEDOT:PSS composite solution was a mixture of PEDOT:PSS, cellulose and glycerol with the ratio of 10:5:8 (ml) and stirred for about 15 min. The PEDOT:PSS composite solution was then poured into petri dish or acrylic mould and dried in an oven at 60 ^{o}C for two days. The PEDOT:PSS composite films was then peeled off and further dried at 120 ^{o}C for 15 min. Films for SEM measurements were prepared by drop-casting the solutions onto silicon substrates. Samples that contained glycerol was washed with DI water and dried before the SEM observation.

Characterisation: The conductivity of the films was measured using four-point method. The current and voltage were applied and measured using 4-wire sensing mode with an Agilent B2901A Precision Source/Measure Unit. Raman spectroscopy was done using Labram HR Evolution (Horiba Japan), 532 nm wavelength, 1% neutral density filter, x100 VIS, acquired time 60 s with 5 accumulations, 1800 (450-850 nm) grating. SEM images were obtained using an analytical field emission SEM (Hitachi SU-70, Japan) operated at 10 kV. Samples were Pt-sputtered using Hitachi E-1045 ion sputter with Pt target and a current of 25 mA for 30 s. ATR-FTIR measurement was done using a Perkin Elmer 100 spectrophotometer (Waltham, MA, USA). The FTIR spectra were acquired in the range of 400–4000 with a resolution of 4 cm^{-1} and averaged over 32 scans. Thermogravimetric analysis was carried out on TGA Q500 with a heating rate of 10 ^{o}C/min to 600 ^{o}C in argon atmosphere. The heating characteristics and thermal images were determined by a Fluke Thermal Imager with an ESCORT 3060TD Dual-tracking DC power supply.

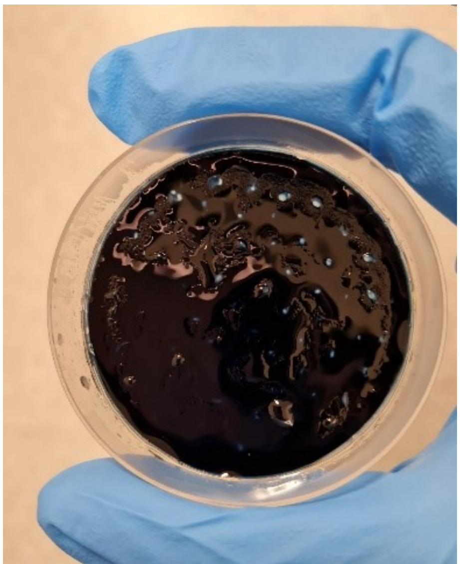

Fig. S1 Photograph of a non-homogeneous PEDOT:PSS/glycerol film formed on a petri dish without the additional of s-cellulose.

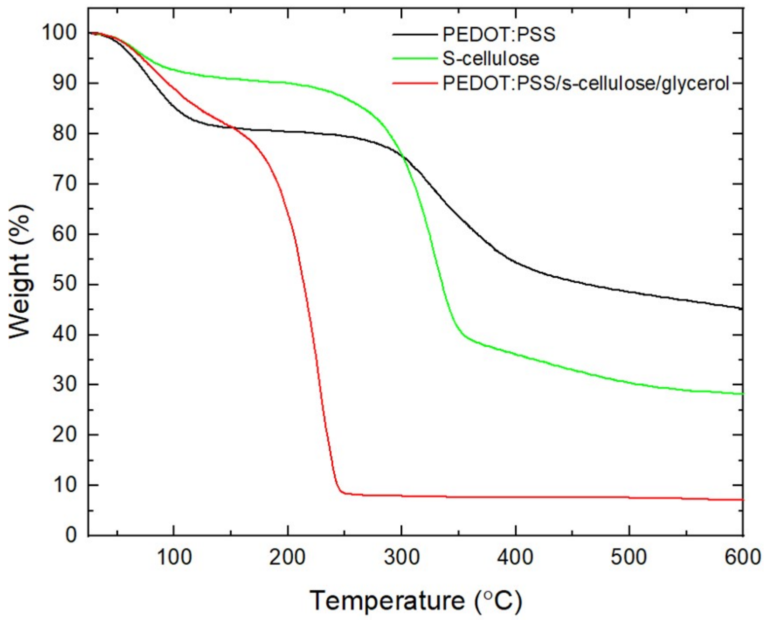

Fig. S2 TGA for PEDOT:PSS, s-cellulose and PEDOT:PSS composite film.

Fig. S3 The setup for the degradation experiment of PEDOT:PSS composite films in soil, with a lamp serving as a simulated sun, operating for a few hours each day.

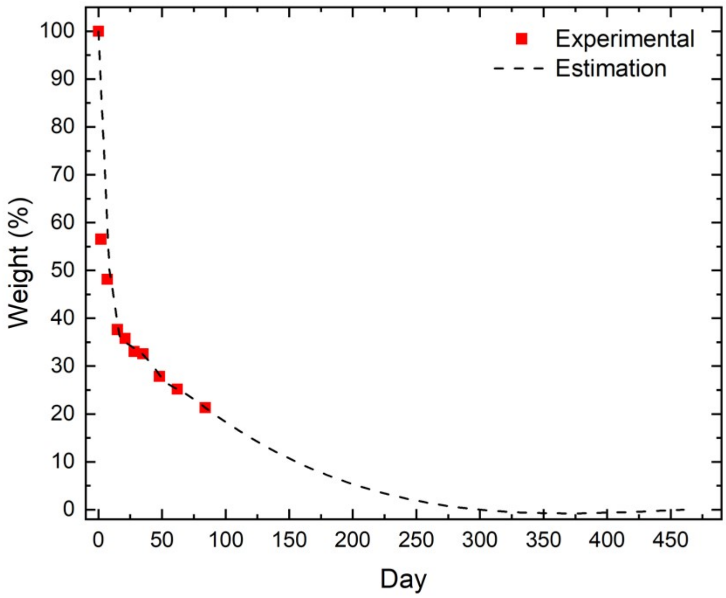

Fig. S4 The estimated number of days required for the complete degradation of the PEDOT:PSS composite film, based on the collected experimental data.

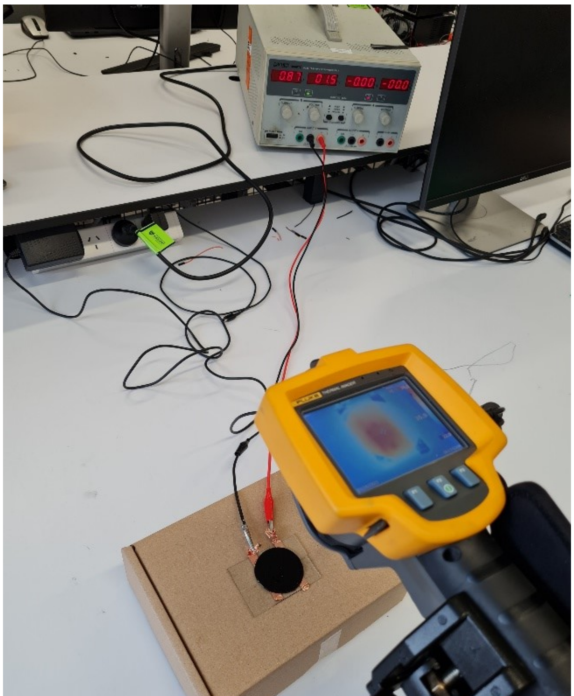

Fig. S5 Photograph of a setup used to measure the heating performance of PEDOT:PSS composite films using a DC power supply.

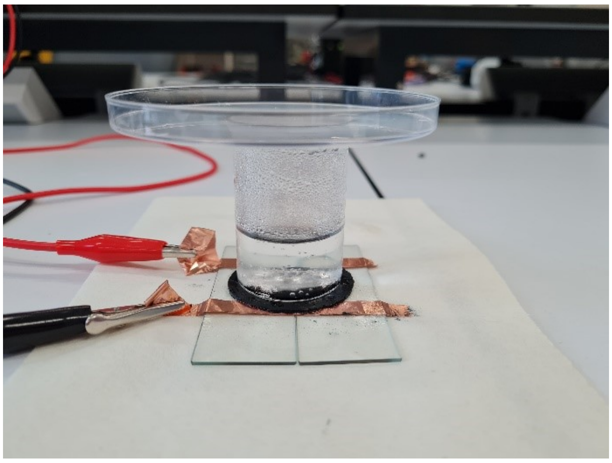

Fig. S6 Heating DI water with PEDOT:PSS composite film.