Electronic Supplementary Material (ESI) for Green Chemistry.

Supporting Information for:

Utilising bio-based plasticiser castor oil and recycled PLA for the production of conductive additive manufacturing feedstock and detection of bisphenol A

Robert D. Crapnell,[1] Iana V.S. Arantes,[1,2] Matthew J. Whittingham,[1] Evelyn Sigley,[1] Cristiane Kalinke,[1,3] Bruno C. Janegitz,[4] Juliano A. Bonacin,[3] Thiago R.L.C. Paixão,[2] and Craig E. Banks[1*]

[1]*Faculty of Science and Engineering, Manchester Metropolitan University, Chester Street, M1 5GD, United Kingdom.*

[2]*Departmento de Química Fundamental, Instituto de Química, Universidade de São Paulo, São Paulo, SP, 05508-000, Brazil.*

[3] *Institute of Chemistry, University of Campinas (Unicamp), 13083-859, São Paulo, Brazil.*

[4]*Laboratory of Sensors, Nanomedicine and Nanostructured Materials, Federal University of São Carlos, Araras, 13600-970, Brazil.*

[*]To whom correspondence should be addressed.

E-mail: c.banks@mmu.ac.uk; Tel: +44(0)1612471196

Table S1. TGA onset temperatures and filler % for all components of recycled filament. The uncertainties in Onset Temperature and Filler Content are the standard deviations of three repeat measurements.

Material	Onset Temperature (°C)	Conductive Filler (wt %)
rPLA	305 ± 5	-
Castor Oil	250 ± 3	-
CB/CO/rPLA Filament	283 ± 3	23 ± 4
Commercial CB/PLA Filament	304 ± 2	21 ± 3

Table S2 – Analytical parameters obtained from the bespoke filament compared to other electrodes found in the literature to determine bisphenol A.

Electrode	Electrode modifier	Technique	Linear range (μM)	LOD (μM)	Real Sample	Reference
GCE	Cu-Zn/GO	SWV	0.2 – 10	0.017	Plastic drinking cups	[1]
GCE	NP-PtFe/GR	DPV	0.2 – 96	0.17	Water	[2]
GCE	rGO-Ag/PLL	DPV	1 – 80	0.54	Drinking water	[3]
Graphene/PLA	DMF and echem activation	DPV	0.5 – 40	0.23	Water, pea water and food packaging	[4]
CB/CO/rPLA	Aqueous echem activation	DPV	0.5 – 10	0.1	Tap and bottled water	This work

GCE – glassy carbon electrode; **PLA** – poly(lactic acid); **CB** – carbon black; **CO** – castor oil; **GO** – graphene oxide; **NP-PtFe** – nanoporous PtFe alloy; **GR** – graphene; **rGO** – reduced graphene oxide; **PLL** – poly(L-lysine); **DMF** – dimethyl formamide; **echem** – electrochemical; **SWV** – square-wave voltammetry; **DPV** – differential pulse voltammetry; **LOD** – limit of detection.

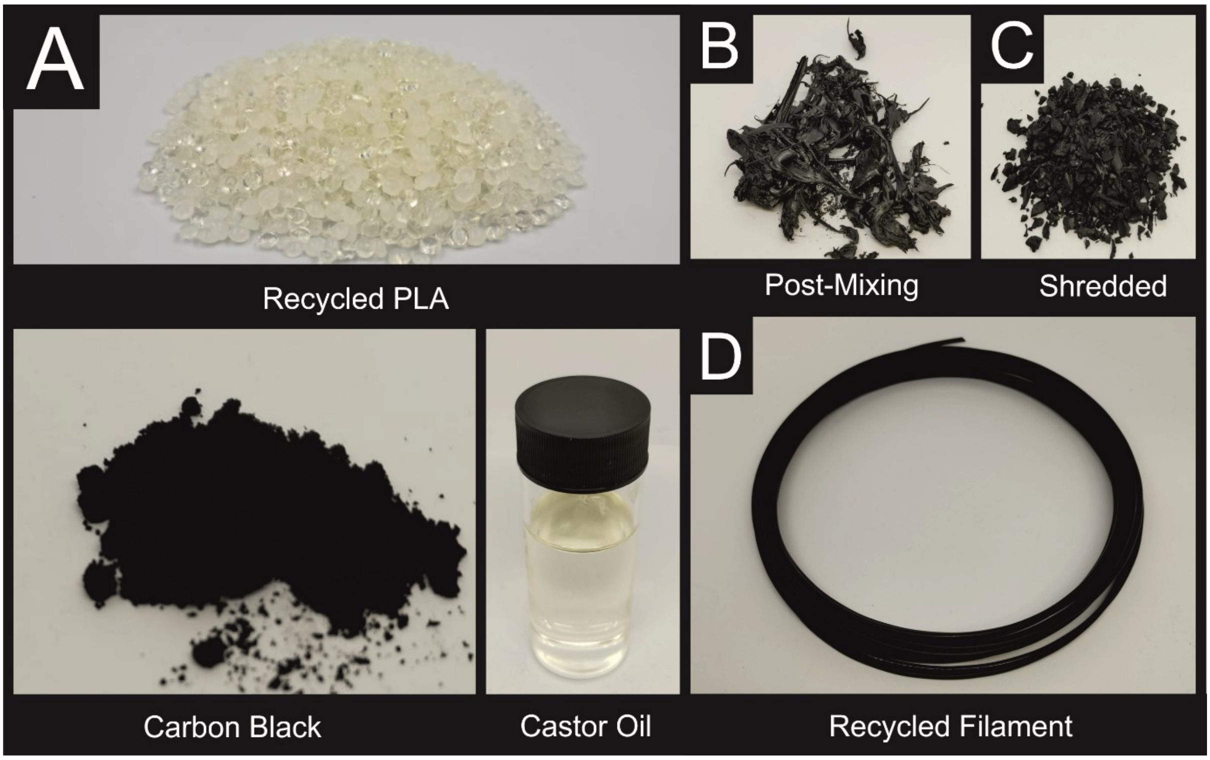

Figure S1. (A) Photograph of the raw materials to make the bespoke filament, recycled PLA, carbon black and castor oil. **(B)** Photograph of the composite after thermal mixing. **(C)** Photograph of the composite after shredding. **(D)** Photograph of the extruded filament.

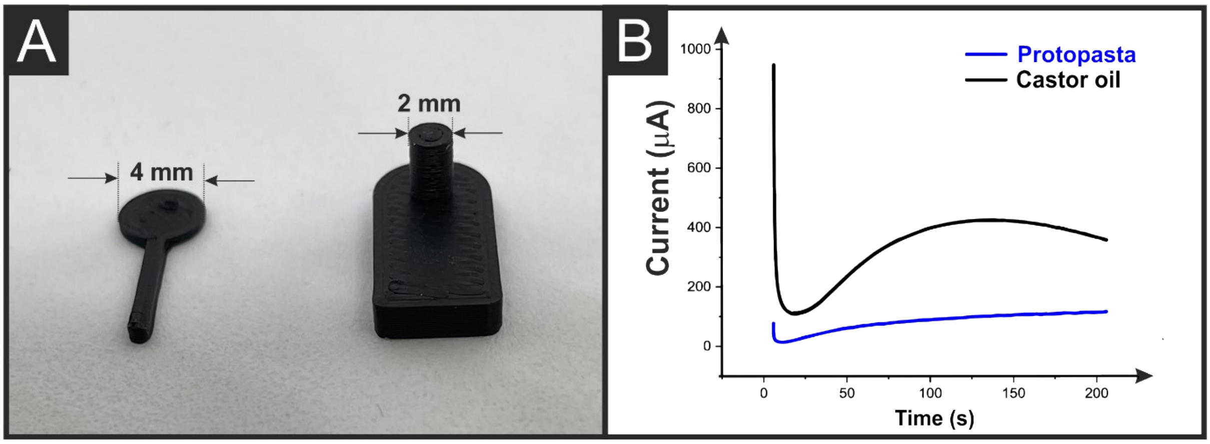

Figure S2. (A) Picture of the lollipop and thicker electrodes used in this work and their respective dimensions. **(B)** Activation electrochemical profile of castor oil/rPLA vs Protopasta in 0.5 M NaOH.

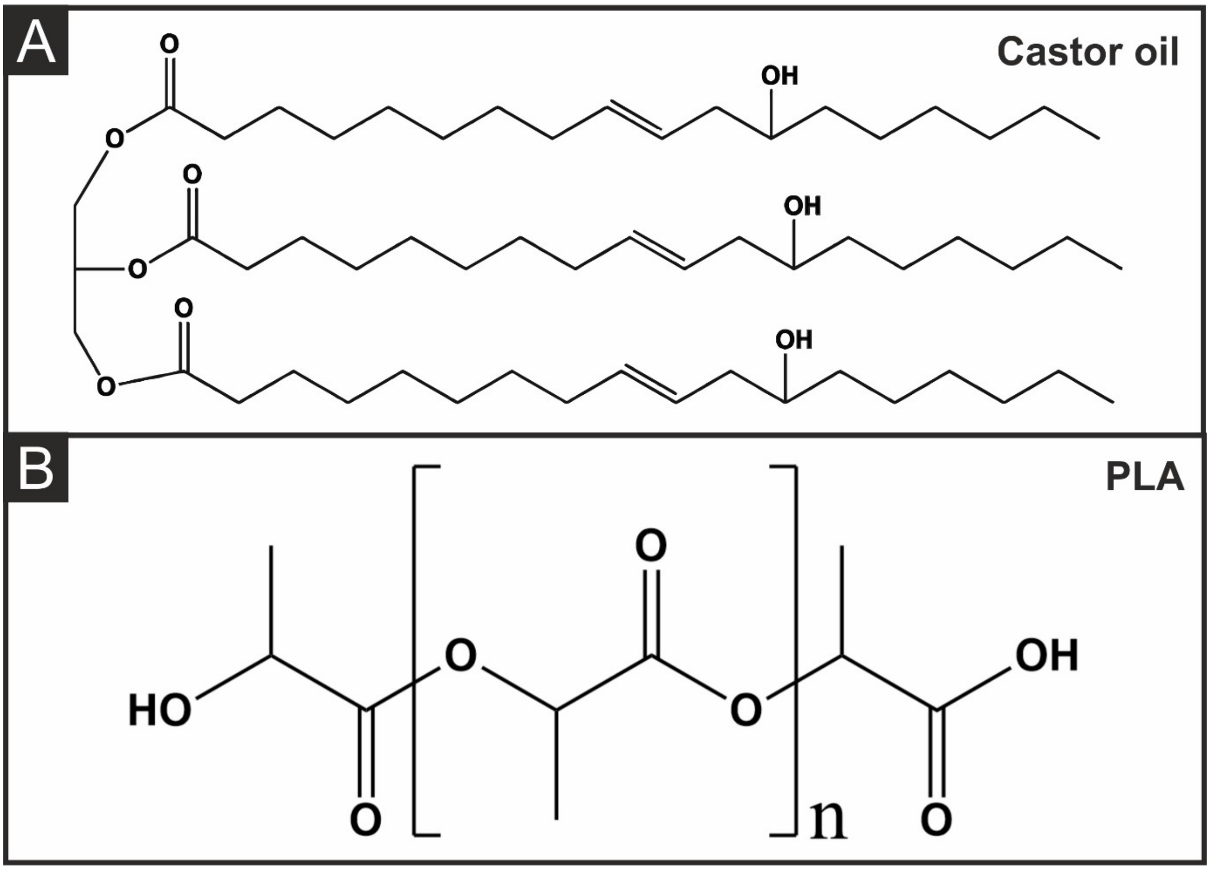

Figure S3. (A) Castor oil and **(B)** PLA structures.

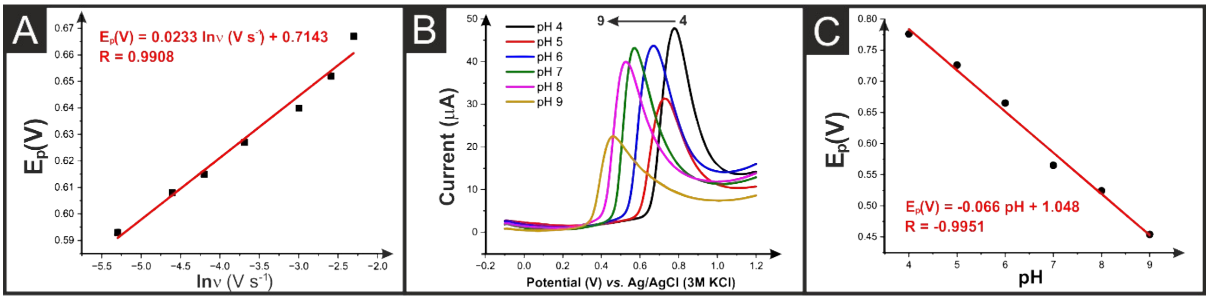

Figure S4. (A) Linear correlation of peak potential (E_p) with natural logarithm of scan rate (lnν) obtained from 100 μmol L^{-1} BPA CVs in 0.1 M PBS pH 7 recorded at different scan rates (5 to 100 mV s^{-1}). **(B)** DPV results of 100 μM BPA in 0.1 M PBS with different pHs (Amplitude: 50 mV; Step potential: 10 mV) and **(C)** the respective linear correlation between E_p and pH.

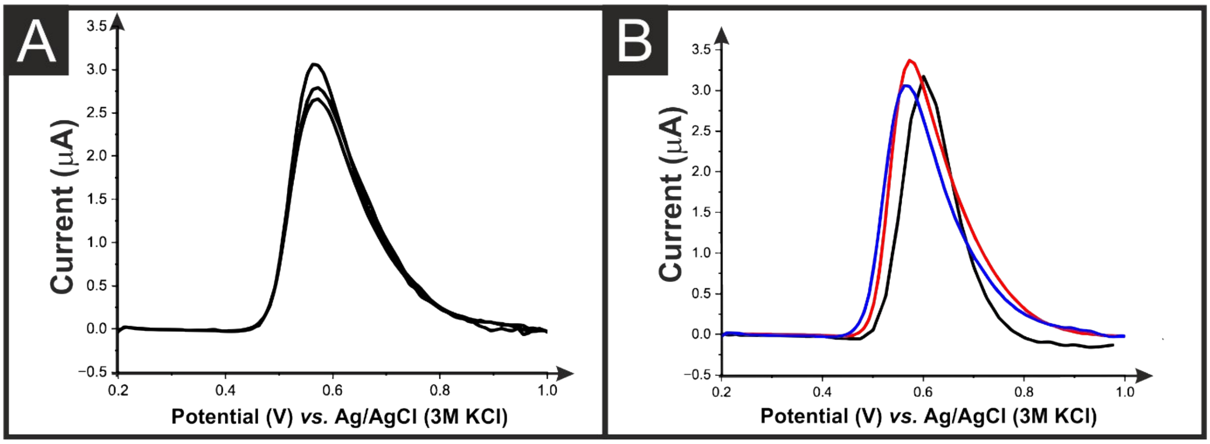

Figure S5. (A) Repeatability measurements of 5 μM BPA (n=3) performed in the same castor oil/rPLA electrode, by polishing between measurements, and **(B)** reproducibility using three different electrodes by DPV. Step potential: 10 mV. Amplitude: 50 mV.

References:

1. Y. Wang, C. Li, T. Wu and X. Ye, *Carbon*, 2018, **129**, 21-28.
2. C. Tian, D. Chen, N. Lu, Y. Li, R. Cui, Z. Han and G. Zhang, *Journal of Electroanalytical Chemistry*, 2018, **830**, 27-33.
3. Y. Li, H. Wang, B. Yan and H. Zhang, *Journal of Electroanalytical Chemistry*, 2017, **805**, 39-46.
4. C. Kalinke, P. R. de Oliveira, N. V. Neumsteir, B. F. Henriques, G. de Oliveira Aparecido, H. C. Loureiro, B. C. Janegitz and J. A. Bonacin, *Analytica Chimica Acta*, 2022, **1191**, 339228.