# Functionalised graphite felt anodes for enhanced power generation in membrane-less soil microbial fuel cells

**Simran Kaur Dhillon[1,2], Jakub Dziegielowski[1], Patit Paban Kundu[2*], Mirella Di Lorenzo[1*]**

[1] Department of Chemical Engineering and Centre for Biosensors, Bioelectronics & Biodevices (C3Bio), University of Bath Claverton Down, BA2 7AY, UK

[2] Department of Chemical Engineering, Indian Institute of Technology, Roorkee, 247667, India

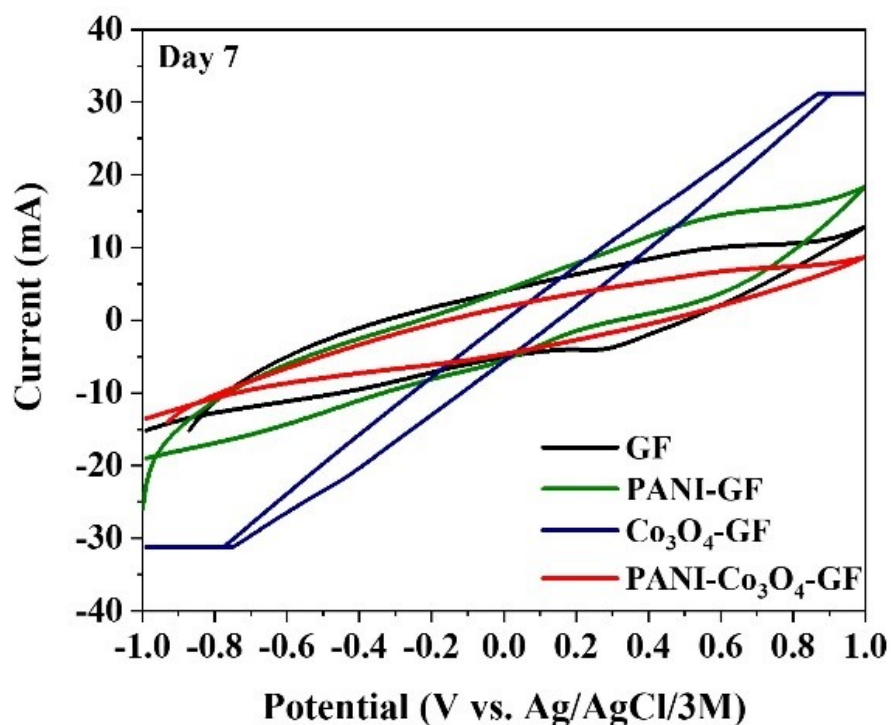*Corresponding authors*: m.di.lorenzo@bath.ac.uk, patit.kundu@ch.iitr.ac.in

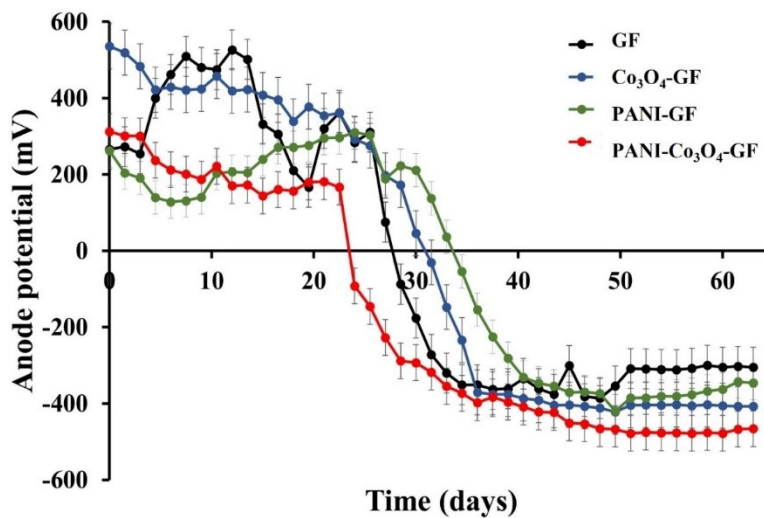**Figure S1.** CV curves of all anodes after 1 week of study.

**Figure S2.** Anode potential evolution over time. The anodes were operated in SMFCs under an applied load of 510 Ω. Error bars refer to three replicates.
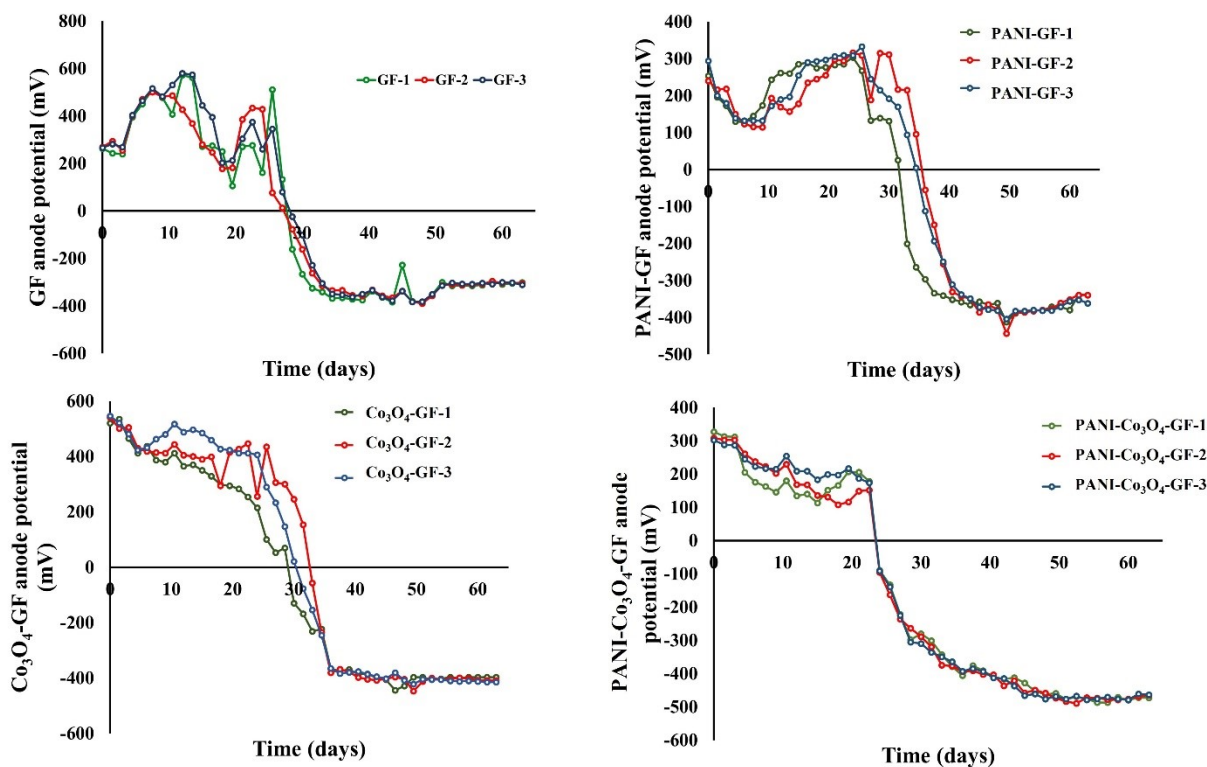


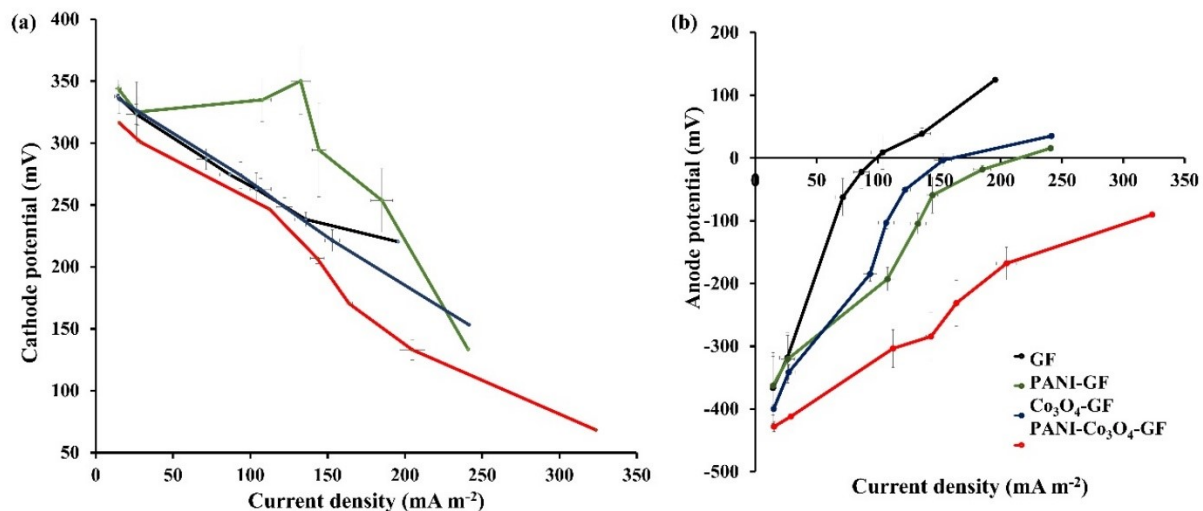**Figure S3. Anode potential with time for all anode replicates.**

**Figure S4.** Electrode potential curves for cathode (a) and anode (b)in SMFCs obtained from polarization study on day 60.

**Table S1.** Elemental composition of PANI/$Co_3O_4$-GF composite anode electrode.

| Element | Wt% |
|---|---|
| C | 76.60 |
| O | 14.73 |
| Cl | 0.10 |
| Fe | 4.79 |
| Co | 2.23 |
| Other impurities | 1.55 |
| **Total** | =100 |

**Table S2.** Optimal performance parameters at different time of SMFC operation.

| Day 7 | | | | | |
|---|---|---|---|---|---|
| **Parameters** | **Resistance ($\Omega$)** | **OCV (mV)** | **CCV (mV)** | **Power density (mW m$^{-2}$)** | **Current density (mA m$^{-2}$)** |
| **GF** | 5000 | $665.9 \pm 38.8$ | $416.6 \pm 104$ | $7.4 \pm 3.5$ | $17.0 \pm 52.5$ |

| | | | | | |
|---|---|---|---|---|---|
| **PANI-GF** | 700 | 303.4 ± 80.2 | 169.3 ± 28.9 | 8.5 ± 2.7 | 49.35 ± 8.4 |
| **Co$_3$O$_4$-GF** | 1000 | 409.4 ± 105 | 334.4 ± 18.4 | 22.8 ± 2.4 | 68.23 ± 3.7 |
| **PANI-Co$_3$O$_4$-GF** | 500 | 381.1 ± 66.8 | 246.2 ± 8.9 | 24.8 ± 1.8 | 100.49 ± 3.6 |
| **Day 30** | | | | | |
| **GF** | 700 | 734.1 ± 33.7 | 239.3 ± 20.8 | 16.8 ± 2.9 | 69.8 ± 6.1 |
| **PANI-GF** | 1000 | 744.6 ± 12.6 | 412.2 ± 60 | 35.2 ± 10.1 | 84.1 ± 12.2 |
| **Co$_3$O$_4$-GF** | 700 | 743.3 ± 5.4 | 449.1 ± 11.7 | 58.8 ± 3.1 | 130.9 ± 3.4 |
| **PANI-Co$_3$O$_4$-GF** | 500 | 788.0 ± 3.4 | 366.2 ± 12 | 54.8 ± 3.5 | 149.5 ± 4.9 |
| **Day 60** | | | | | |
| **GF** | 300 | 807.7 ± 5.5 | 199.6 ± 14.0 | 27.2 ± 3.7 | 135.8 ± 9.5 |
| **PANI-GF** | 700 | 792.1 ± 33.6 | 454.7 ± 19.4 | 60.4 ± 5.1 | 132.6 ± 5.6 |
| **Co$_3$O$_4$-GF** | 1000 | 798.3 ± 34 | 458.8 ± 3.9 | 42.9 ± 0.7 | 93.6 ± 0.8 |
| **PANI-Co$_3$O$_4$-GF** | 700 | 770.4 ± 35.1 | 491.4 ± 5.1 | 70.4 ± 1.4 | 143.2 ± 1.4 |

(Data are the average of three replicates)