Electronic Supplementary Information

# An Eco-friendly polycaprolactone/graphite composite as a robust freestanding electrode platform for supercapacitive energy storage

**Rajeev Gupta[1*], Monika Singhal[2]**
*[1*] Department of Applied Chemistry, School of Sciences, ITM(SLS) Baroda University, Vadodara, Gujarat 391510, India*
*[2] Shree PM Patel Institute of PG Studies and Research in Science (Affiliated to Sardar Patel University VV Nagar), Anand, Gujarat 388001, India*
***Correspondence: E-mail:** rajeevguptachem@gmail.com

**Table S1:** Preparation of PCL-graphite composites with different compositions.

| Sr. No. | Sample Code | Composition of PCLGr (wt%) | PCL content | Graphite content | Extra added chloroform |
|---|---|---|---|---|---|
| 1. | PCL1Gr9 | PCL (10%): Graphite (90%) | 10 % soln. of PCL (4.05 mL) | Graphite powder (3.64 g.) | 7 mL $CHCl_3$ |
| 2. | PCL2Gr8 | PCL (20%): Graphite (80%) | 10 % soln. of PCL (8.10 mL) | Graphite powder (3.24 g.) | 4 mL $CHCl_3$ |
| 3. | PCL3Gr7 | PCL (30%): Graphite (70%) | 10 % soln. of PCL (12.15 mL) | Graphite powder (2.83 g.) | 1 mL $CHCl_3$ |
| 4. | PCL4Gr6 | PCL (40%): Graphite (60%) | 10 % soln. of PCL (16.20 mL) | Graphite powder (2.43 g.) | - |
| 5. | PCL5Gr5 | PCL (50%): Graphite (50%) | 10 % soln. of PCL (20.25 mL) | Graphite powder (2.02 g.) | - |
| 6. | PCL6Gr4 | PCL (60%): Graphite (40%) | 10 % soln. of PCL (24.30 mL) | Graphite powder (1.62 g.) | - |
| 7. | PCL7Gr3 | PCL (70%): Graphite (30%) | 10 % soln. of PCL (28.35 mL) | Graphite powder (1.21 g.) | - |
| 8. | PCL8Gr2 | PCL (80%): Graphite (20%) | 10 % soln. of PCL (32.40 mL) | Graphite powder (0.81 g.) | - |
| 9. | PCL9Gr1 | PCL (90%): Graphite (10%) | 10 % soln. of PCL (36.45 mL) | Graphite powder (0.40 g.) | - |

**More details of the preparation:** The preparation process involved adjusting the slurry viscosity by adding extra solvent, particularly for high graphite content samples, to ensure uniform spreading in the mold. This additional solvent, as indicated in **Table S1**, facilitated the formation of uniform films in the mold. For compositions with higher PCL content, the need for extra chloroform diminished as the solvent ratio increased proportionally.

All sample compositions, as detailed in the table, were cast into glass molds and covered with thin paper (**Figure S1a**) before being left to dry at room temperature for one day. Photographs of the dried samples' top surfaces are depicted in **Figure S1b to S1j**. It's noteworthy that top surfaces of PCL1Gr9 to PCL5Gr5 are smooth, while those with lower graphite content appear non-uniform, echoing the observations made with PLA-based electrode films in our previous work. Interestingly, PCL, as a binder, forms more uniform films up to a composition of 60% PCL and 40% graphite. This can be attributed to the greater compactness and flexibility of PCL films. These composite films were easily peeled off from the glass substrate, and the bottom surfaces of all PCL-graphite composite films were smooth. Finally, all samples were stored in airtight plastic pouches for further analysis, including bulk conductivity testing to identify the most suitable composition.

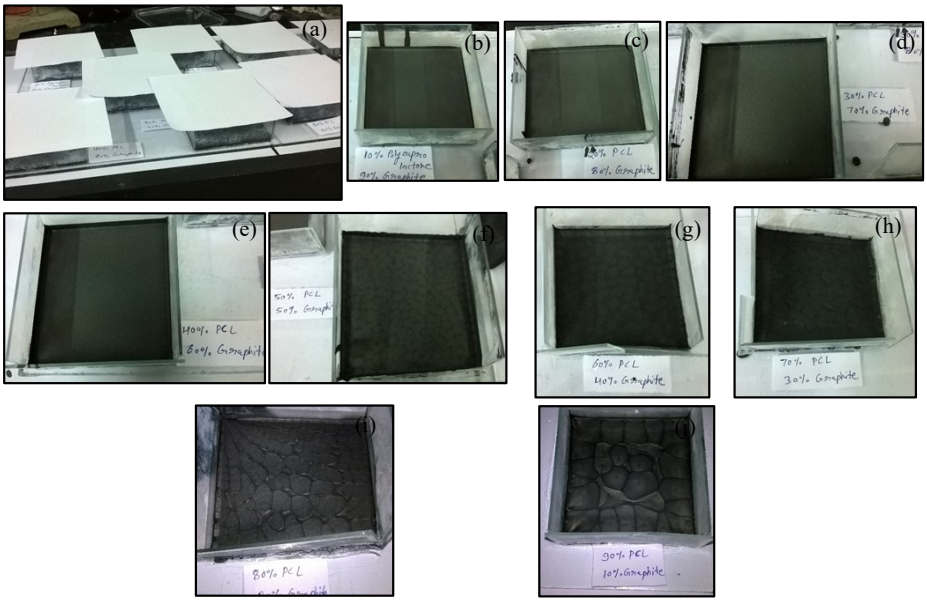


**Figure S1:** (a) Slurries are covered with thin papers during drying process; Top surface photographs of dried samples of PCL-Graphite composites with different compositions (b) PCL1Gr9 (c) PCL2Gr8 (d) PCL3Gr7 (e) PCL4Gr6 (f) PCL5Gr5 (g) PCL6Gr4 (h) PCL7Gr3 (i) PCL8Gr2 (j)PCL9Gr1

**Table S2:** Weight of PANI deposited over PCL4Gr6.

| Sr. No. | Electroactive material | Measured weight of deposited material on current collectors (grams) |
|---|---|---|
| 1. | PANI (deposited on PCL4Gr6) | 0.0012 gram |

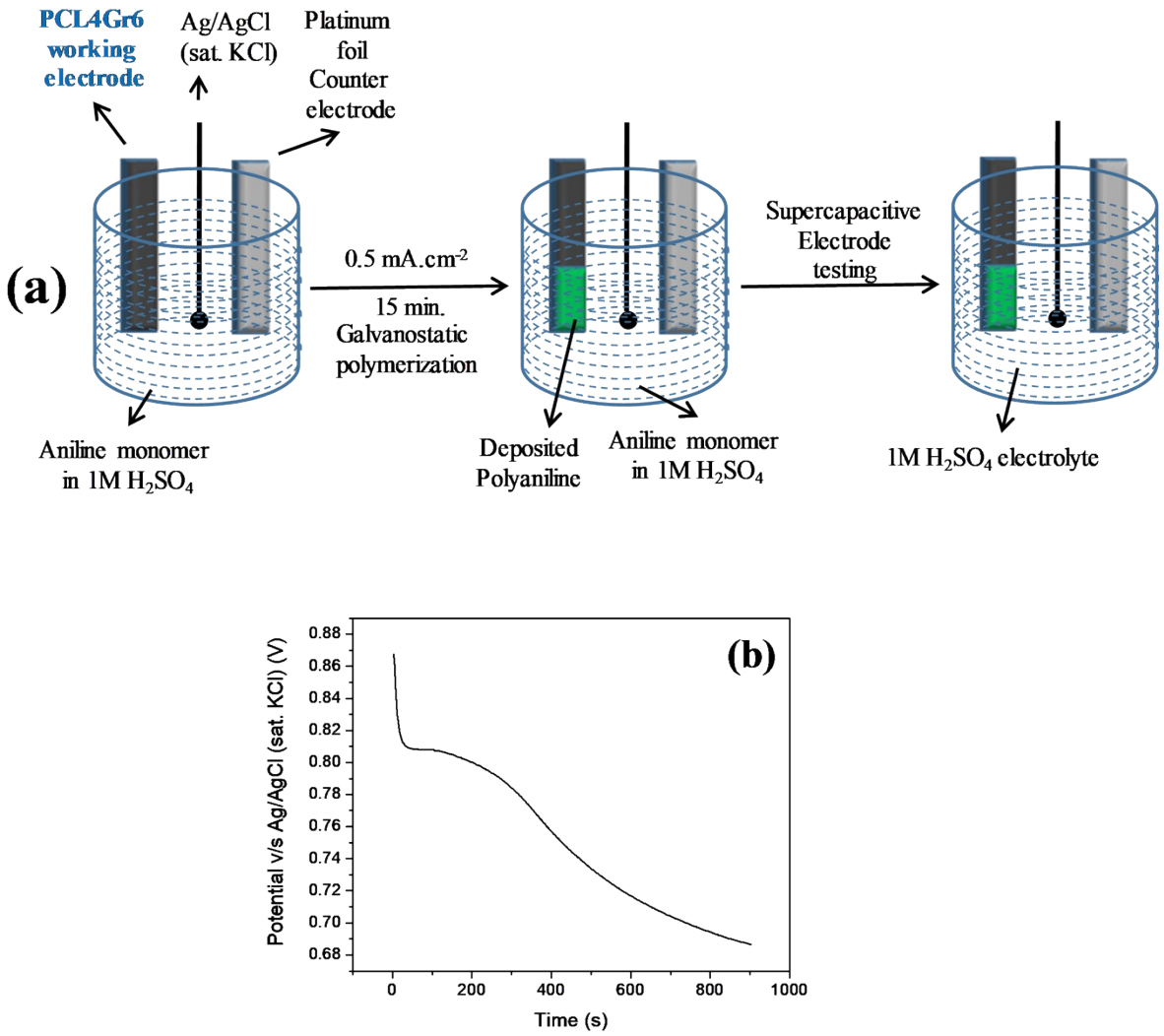


**Figure S2:** (a) Schematic of Polyaniline polymerization on PCL4Gr6 electrode; (b) Galvanostatic polymerization curve of polyaniline on PCL4Gr6 electrode.

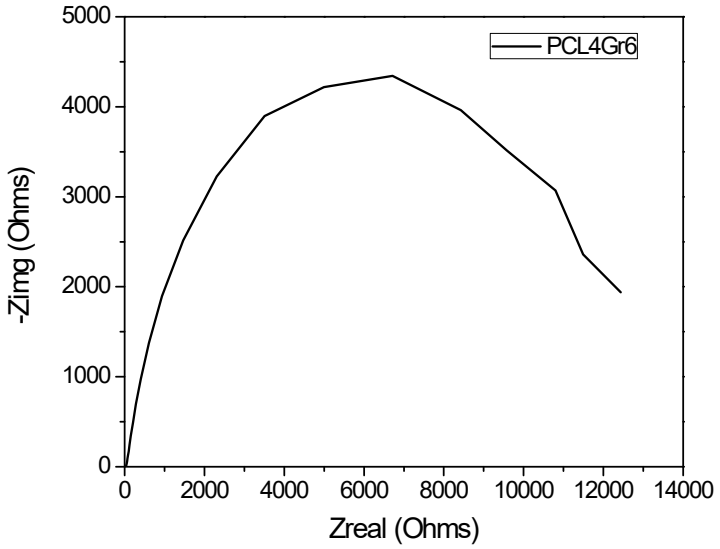


**Figure S3:** Nyquist plot of PCL4Gr6 current collector in 1 M $H_2SO_4$