

SUPPORTING INFORMATION

Electrochemically Modified Graphite Paper as an Advanced Electrode substrate for Supercapacitor Application

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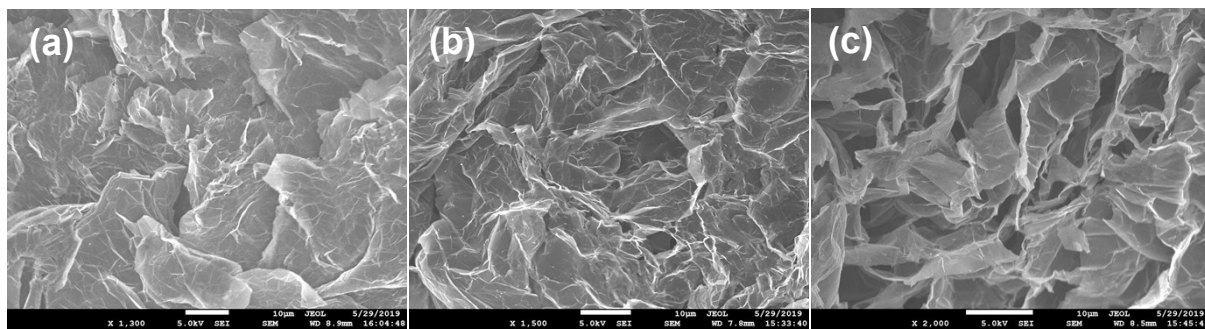


Figure S1. FESEM images of (a) ECM-GP5, (b) ECM-GP10 and (c) ECM-GP30.

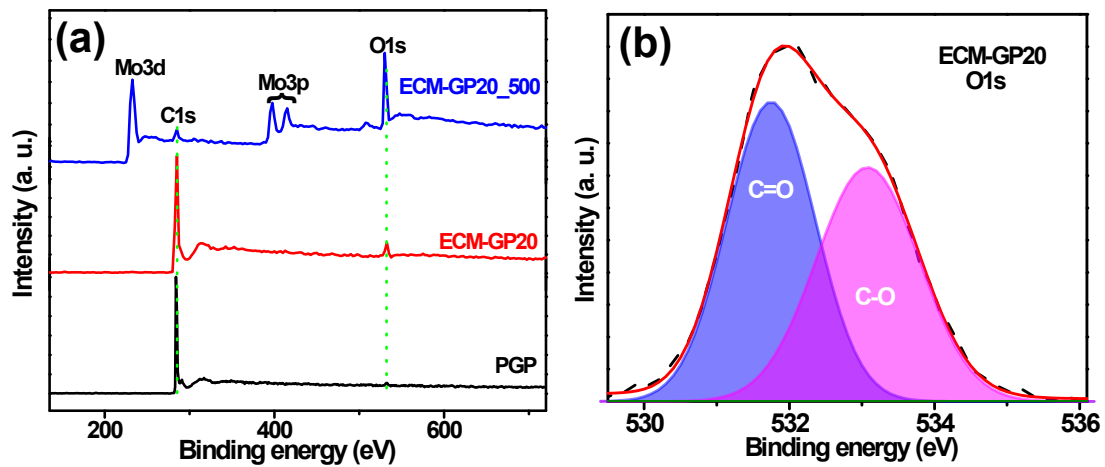


Figure S2. (a) represents the XPS survey spectra of PGP, ECM-GP20 and ECM-GP20_500 electrodes. (b) represents the deconvolution of highly resolved O1s spectra of ECM-GP20 electrode substrate.

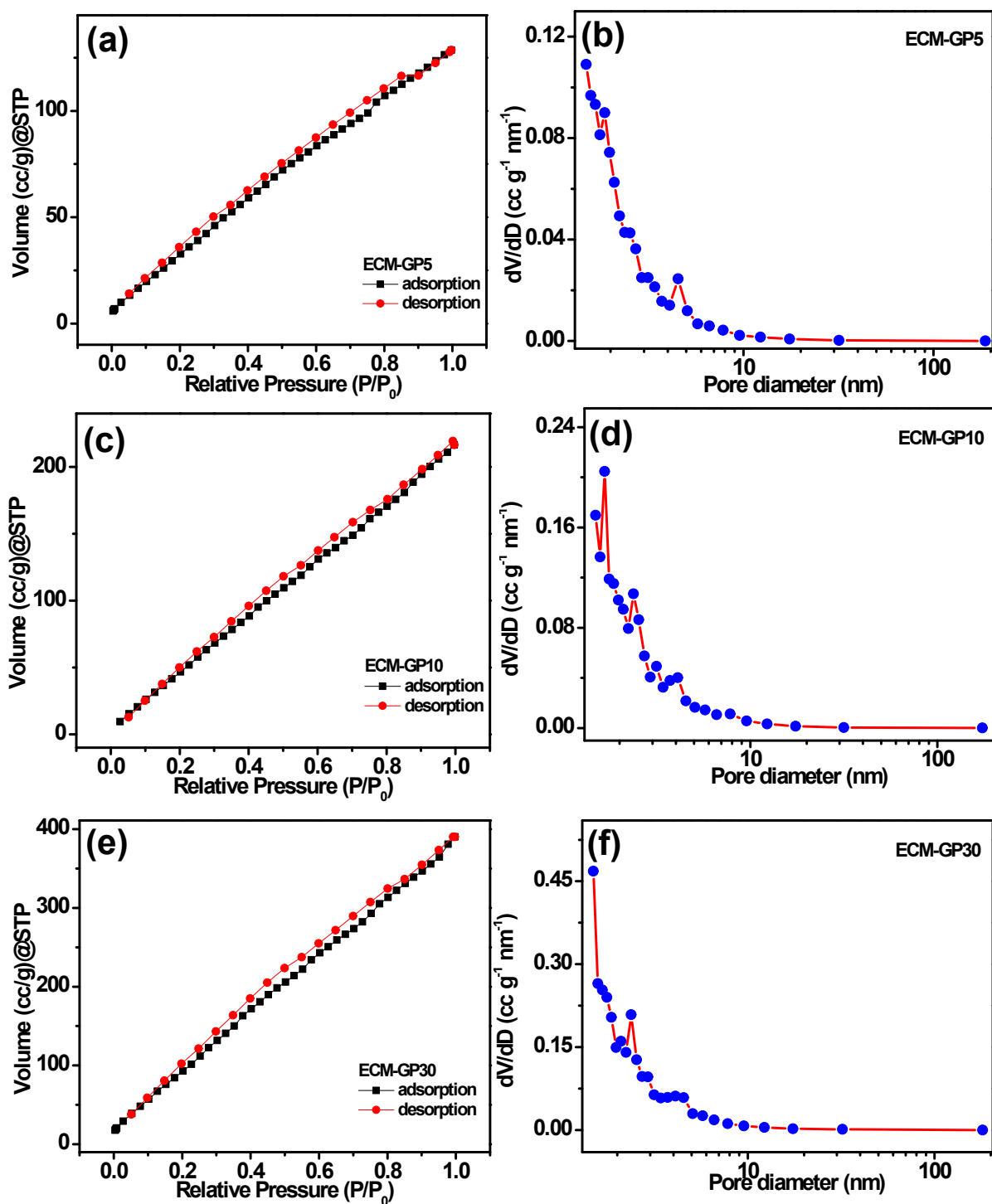


Figure S3. N_2 adsorption/desorption isotherm of (a) ECM-GP5 (c) ECM-GP10 and (e) ECM-GP30. (b), (d) and (f) represent the pore size distribution in ECM-GP5, ECM-GP10 and ECM-GP30, respectively.

Table S1. Summary of BET surface area and pore volume.

sample	Surface area (m² g⁻¹)	Pore volm (cc g⁻¹)
PGP	28.6	0.04
ECM-GP5	183	0.199
ECM-GP10	320	0.33
ECM-GP20	560	0.766
ECM-GP30	517.6	0.604

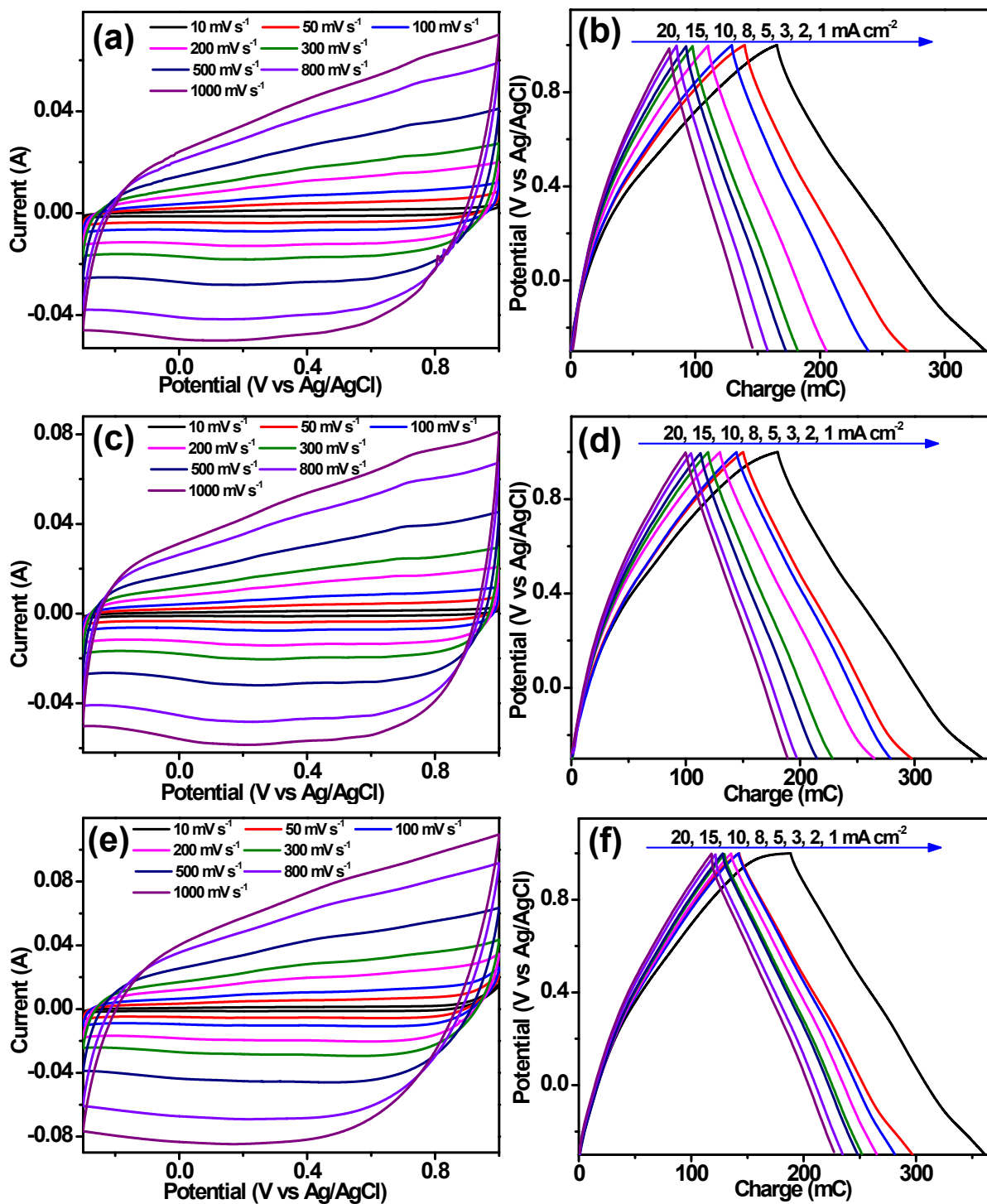


Figure S4. (a) CV and (b) GCD plots of ECM-GP5 electrode. (c) CV and (d) GCD plots of ECM-GP10 electrode. (e) CV and (f) GCD plots of ECM-GP30 electrode.

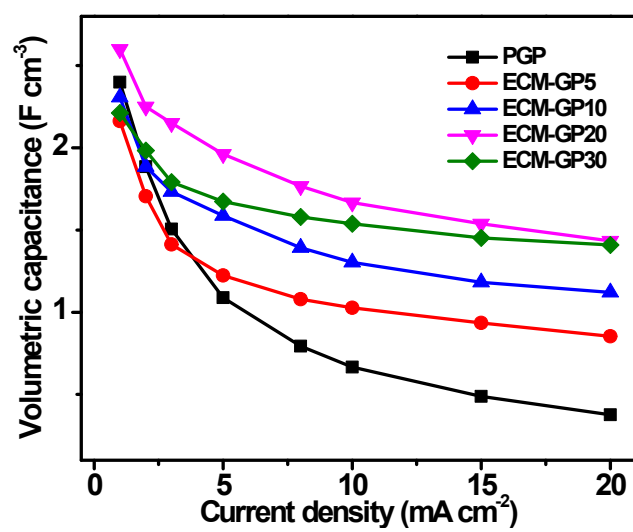


Figure S5. Volumetric capacitance of PGP, ECM-GP5, ECM-GP10, ECM-GP20 and ECM-GP30 for different current densities.

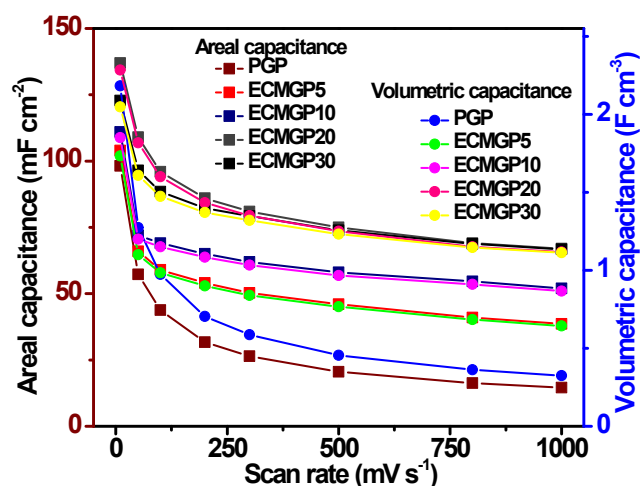


Figure S6. Areal and volumetric capacitance of PGP and all ECM-GP electrodes for different scan rates.

The PGP shows capacitance of 98.2 mF cm^{-2} (2.18 F cm^{-3}) at 10 mV s^{-1} scan rate having very poor retention ability of 14.87% at 1 V s^{-1} compare to that at 10 mV s^{-1} . The electrochemical exfoliation-oxidation strategy of graphite paper significantly boosts its supercapacitor properties and it varies with exfoliation time. ECM-GP5, ECM-GP10, ECM-GP20, ECM-GP30 shows areal capacitance of 104, 111, 137 and 122 mF cm^{-2} (corresponding volumetric capacitance is 1.73, 1.85, 2.3 and 2.05 F cm^{-3} , respectively), respectively, at 10 mV s^{-1} , with retention ability of 37.12, 44.85, 48.9 and 54.4%, respectively, at 1 V s^{-1} compare to that at 10 mV s^{-1} . Here, the regular increment of the capacitance retention ability from ECM-GP5 to ECM-GP30, arises because of more exfoliation of graphite sheets with time and formation of more porous structure (cf. **Figure S1**, **Figure 2** and **Figure S3**). However, the CV curve clearly indicates that among all ECM-GP electrodes ECM-GP20 exhibits best charge storage performance at all scan rates, even better than ECM-GP30 electrode. The reason behind this

is that though with time more exfoliation of graphite sheets take place, but excess exfoliation i.e. more than 20 mins causes detaches of more exfoliated graphite sheets from ECM-GP electrode. So, we focus on only ECM-GP20 electrode for its better electrochemical performance. So, the CV result suggests to use ECM-GP20 as electrode substrate.

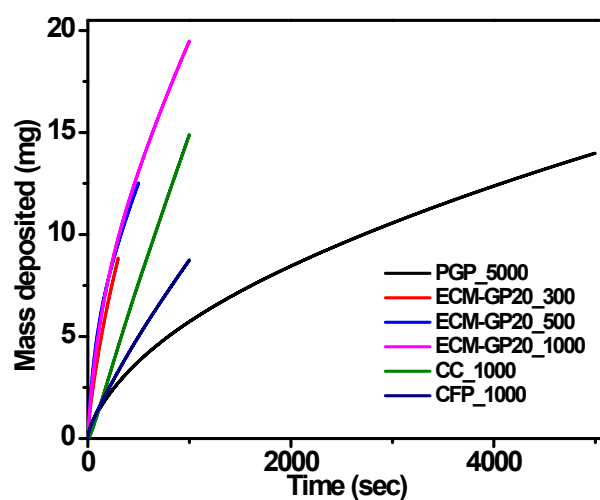


Figure S7. Amount of MoO₂ (mg) deposition with time (sec) during preparation of PGP_5000, ECM-GP20_300, ECM-GP20_500, ECM-GP20_1000, CC_1000 and CFP_1000 electrode. The Figure indicates that deposition rate in PGP electrode substrate is very low compare to that at ECM-GP electrodes.

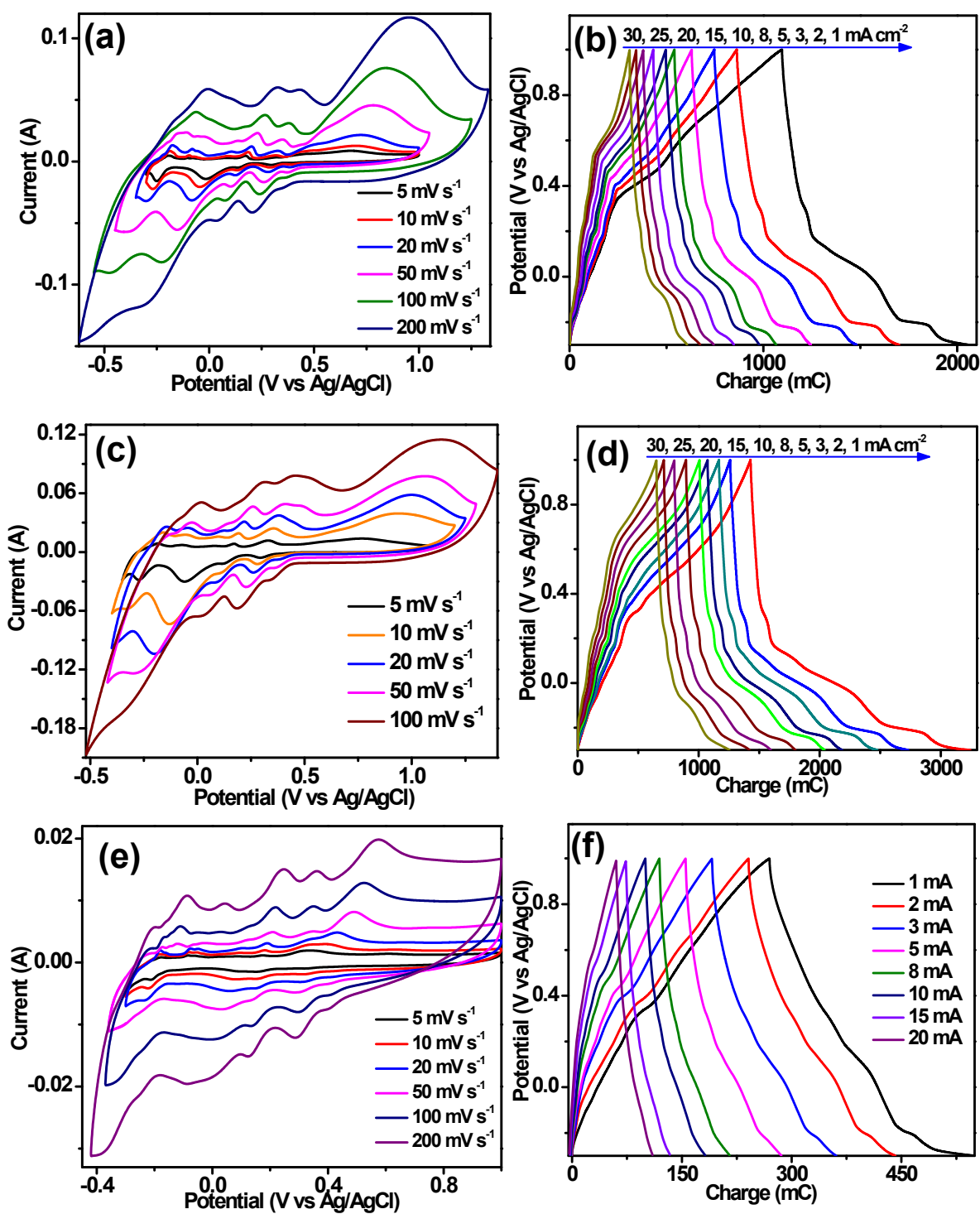


Figure S8. (a) CV and (b) GCD plots of ECM-GP20_300 electrode; (c) and (d) represent CV and GCD plots, respectively of ECM-GP20_1000 electrode; (e) CV and (f) GCD plot of PGP_1500 electrode.

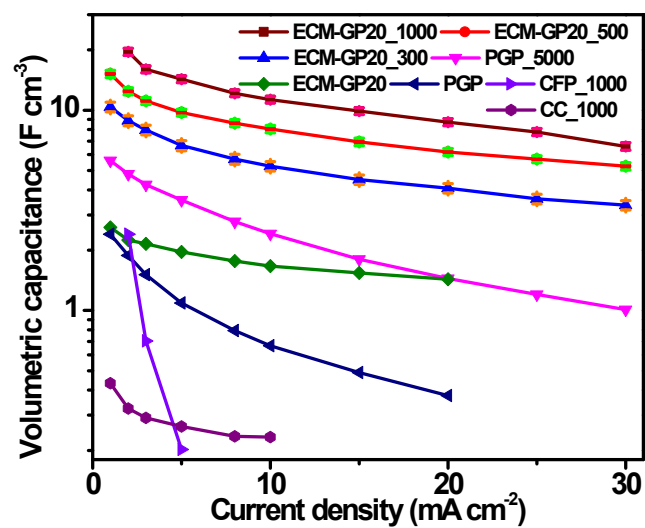


Figure S9. Volumetric capacitance of all electrodes (PGP, ECM-GP20, PGP_5000, ECM-GP20_300, ECM-GP20_500, ECM-GP20_1000, CFP_1000 and CC_1000) for different applied current density.

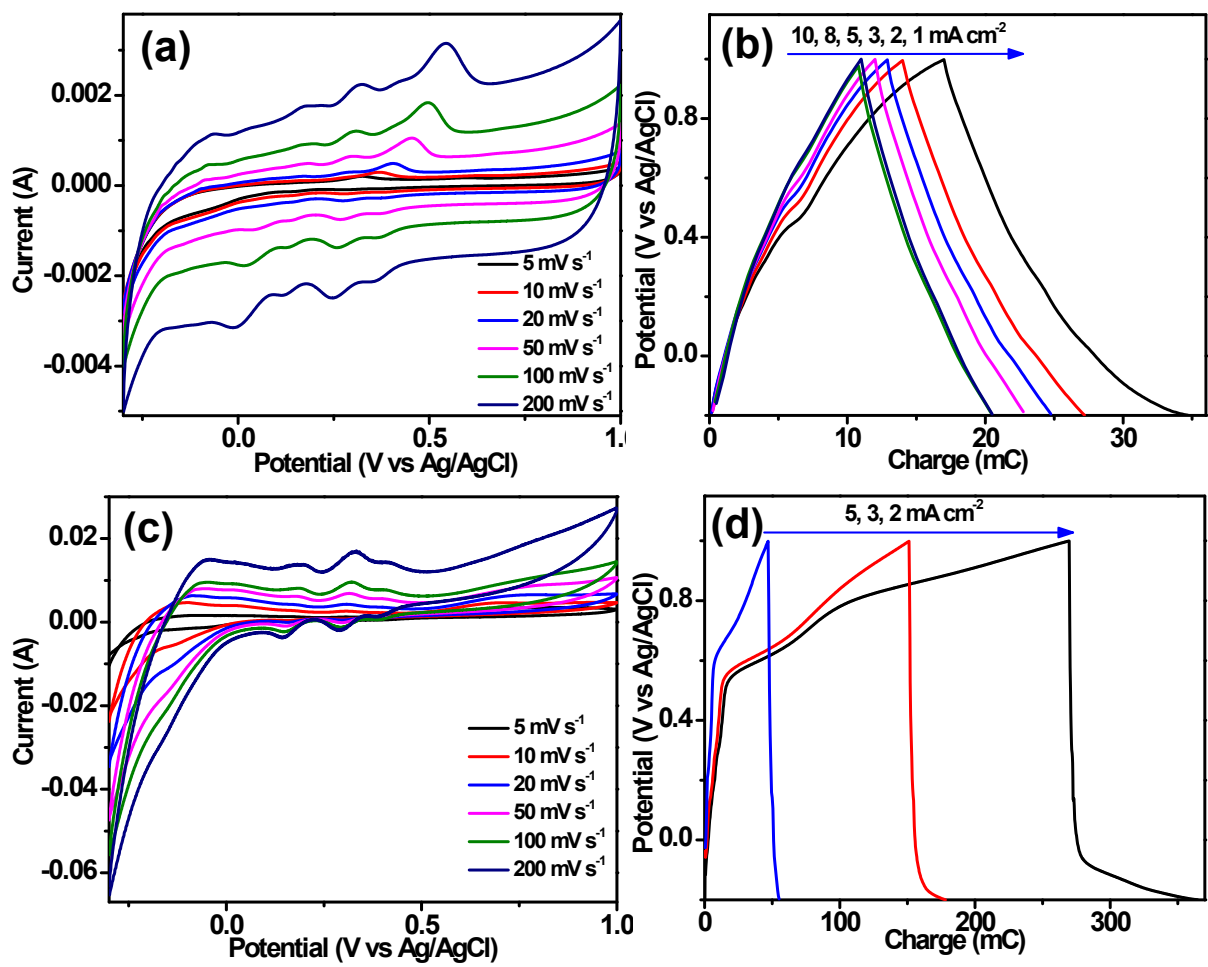


Figure S10. (a) CV and (b) GCD plot of CC_1000 electrode. (c) and (d) represent CV and GCD plot, respectively, of CFP_1000 electrode.

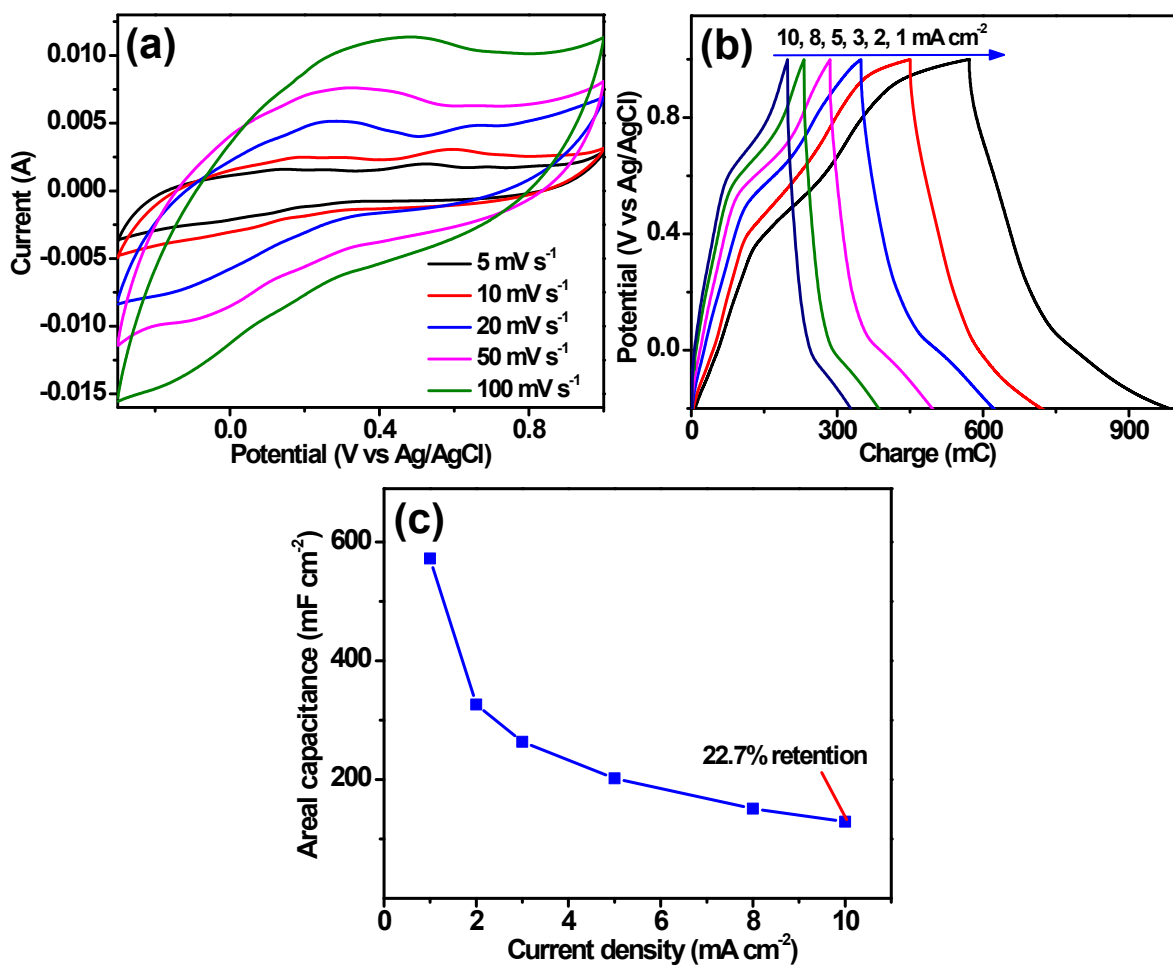


Figure S11. (a) CV and (b) GCD plot of ECM-GP20_500 electrode in 0.25 M tetrabutylammonium hexafluorophosphate (TBAPF₆, >98%) in acetonitrile (ACN). (c) represents corresponding capacity retention plot of ECM-GP20_500 electrode with current density in same ionic liquid electrolyte.

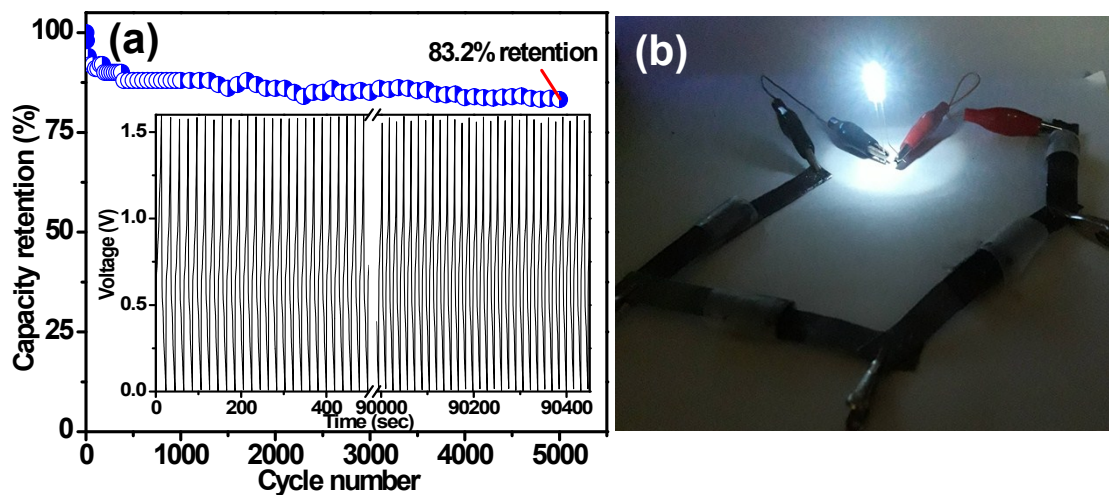


Figure S12. (a) Cyclic performance test of ECM-GP_500// ECM-GP_500 SSC at 30 mA current; it exhibits 83.2% capacity retention after 5000 cycles. Inset of this figure respective GCD plots are shown. (b) represents optical image of powering of a 3 mm LED bulb by charged SSCs where four SSCs are connected in a series.