Supporting Information

Using Asphaltene Supermolecules Derived from Coal for the Preparation of Efficient Carbon Electrodes for Supercapacitors

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Structural Characteristics of Samples and their Raw Materials:

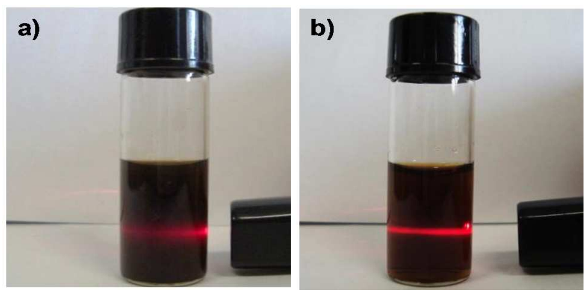

Figure S1. (a) Optical images of asphaltene oxide dispersed in tetrahydrofuran and (b) graphene oxide dispersed in water.

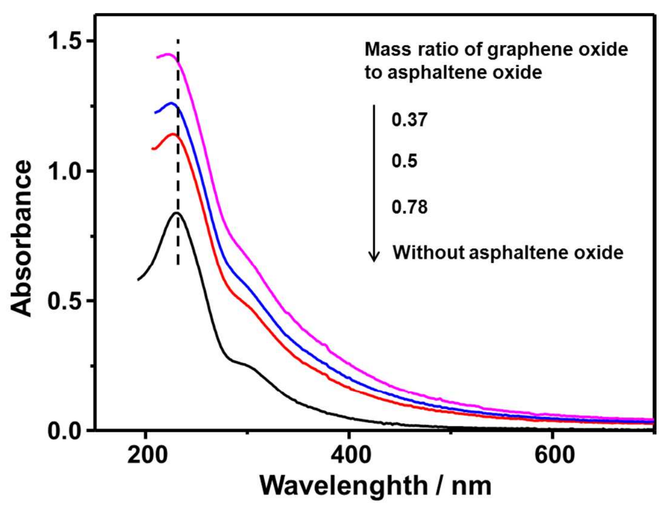

Figure S2. UV-vis absorption spectra of graphene oxide and graphene oxide/asphaltene oxide dispersions with different mass ratios of graphene oxide to asphaltene oxide. The concentration of graphene oxide in all dispersions is 0.00144 mg mL^{-1}.

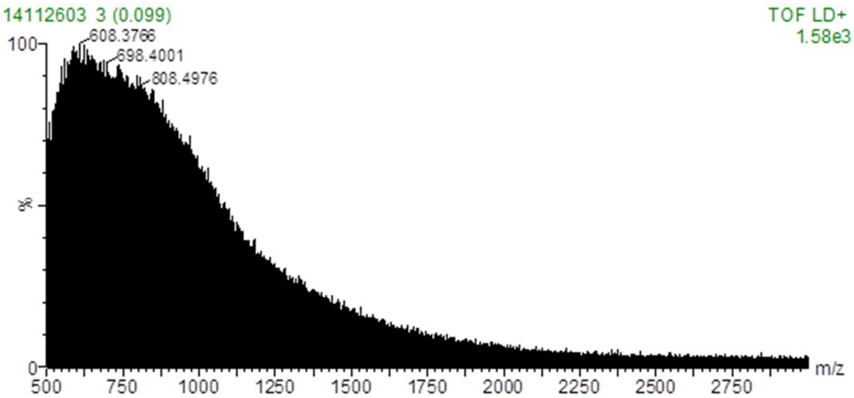

Figure S3. MALDI mass spectrum of asphaltene oxide in tetrahydrofuran.

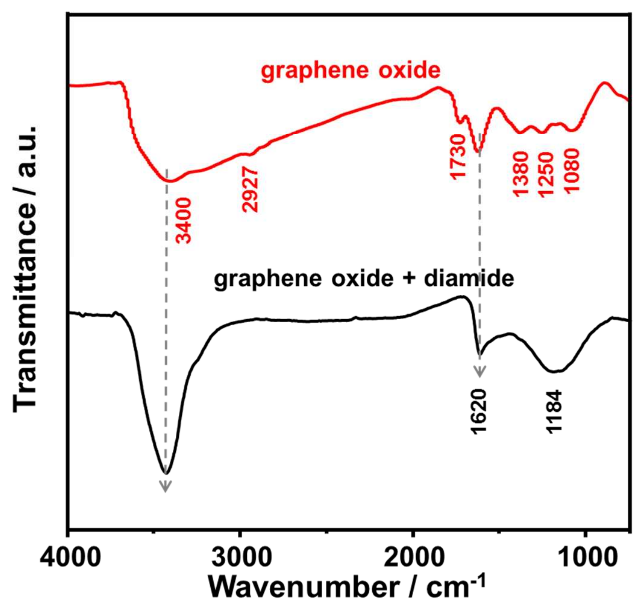

Figure S4. FT-IR spectra of graphene oxide and the sample without asphaltene(graphene oxide+diamide).

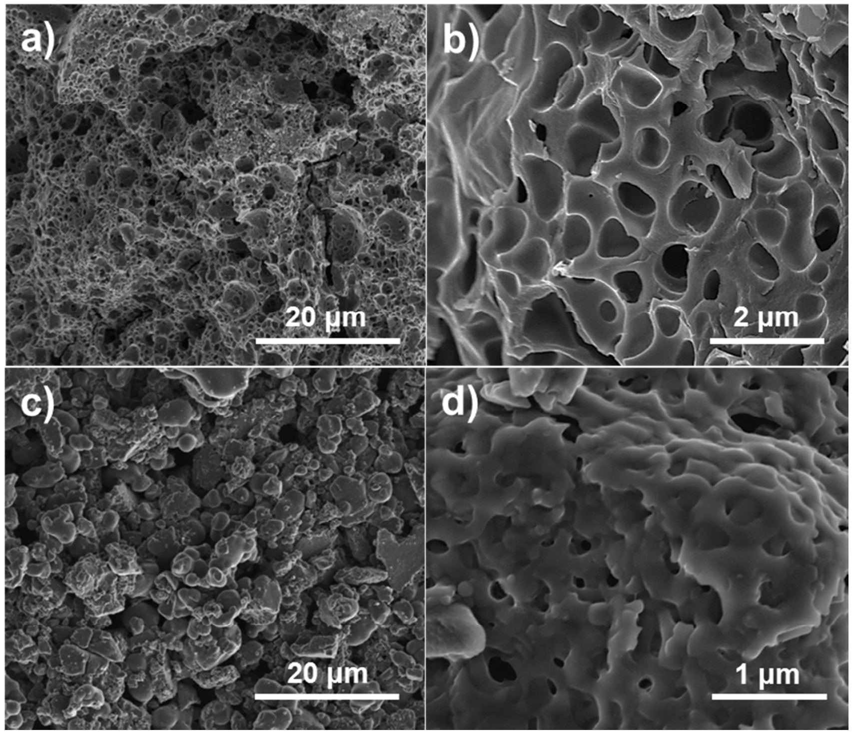

Figure S5. SEM images of (a, b) ACN-0.005 and (c, d) ACN-0.

Electrochemical Performance of the Asphaltene-derived Carbon:

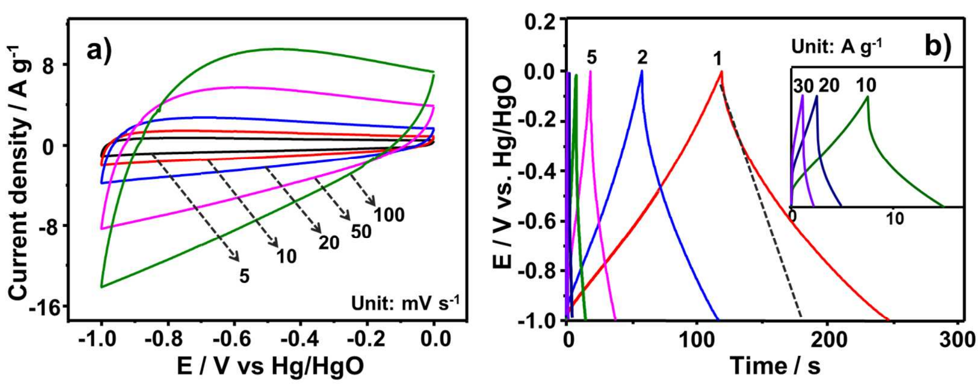

Figure S6. (a) CV curves of ACN-0 at scan rates of 5, 10, 20 50 and 100 mV s^{-1}; (b) GC curves of ACN-0 at current densities of 1, 2, 5, 10, 20 and 30 A g^{-1}. Inset is the enlarged GC curves at current densities of 10, 20 and 30 A g^{-1}.

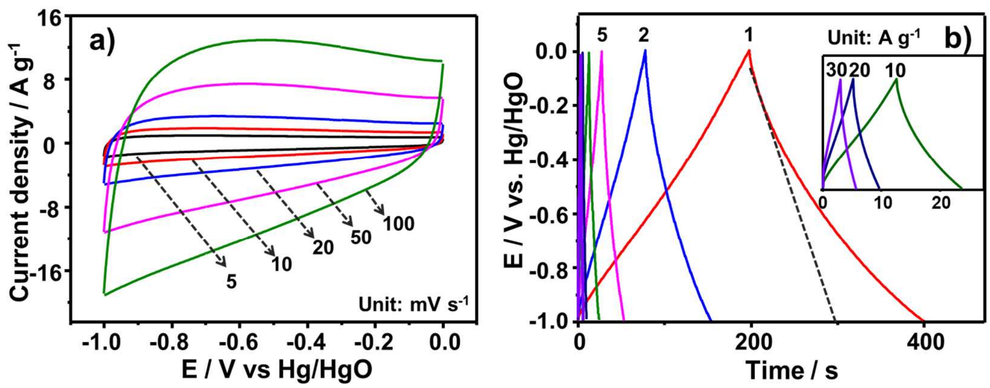

Figure S7. (a) CV curves of ACN-0.005 at scan rates of 5, 10, 20 50 and 100 mV s^{-1}; (b) GC curves of ACN-0.005 at current densities of 1, 2, 5, 10, 20 and 30 A g^{-1}. Inset is the enlarged GC curves at current densities of 10, 20 and 30 A g^{-1}.

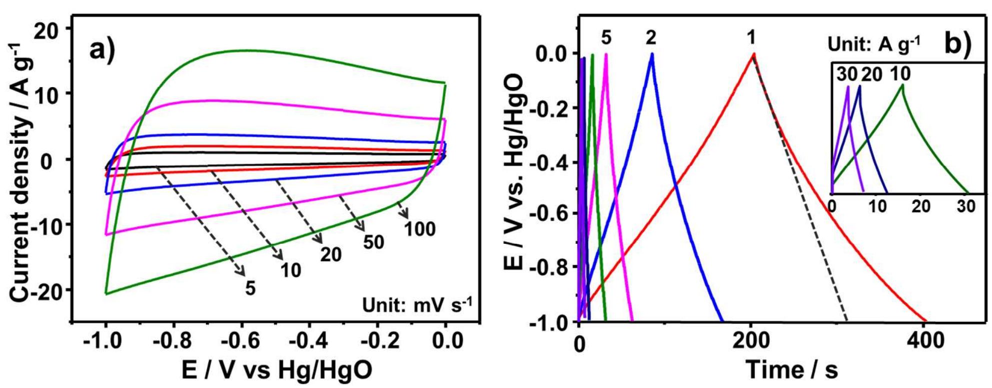

Figure S8. (a) CV curves of ACN-0.01 at scan rates of 5, 10, 20 50 and 100 mV s^{-1}; (b) GC curves of ACN-0.01 at current densities of 1, 2, 5, 10, 20 and 30 A g^{-1}. Inset is the enlarged GC curves at current densities of 10, 20 and 30 A g^{-1}.

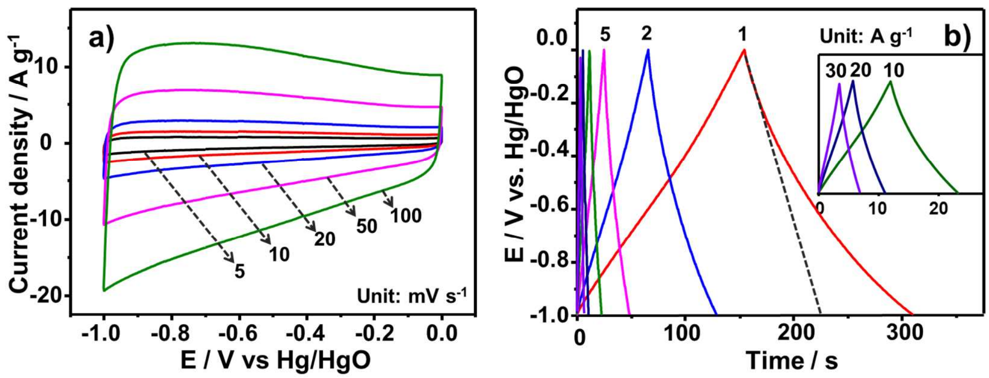

Figure S9. (a) CV curves of ACN-0.1 at scan rates of 5, 10, 20 50 and 100 mV s^{-1}; (b) GC curves of ACN-0.1 at current densities of 1, 2, 5, 10, 20 and 30 A g^{-1}. Inset is the enlarged GC curves at current densities of 10, 20 and 30 A g^{-1}.

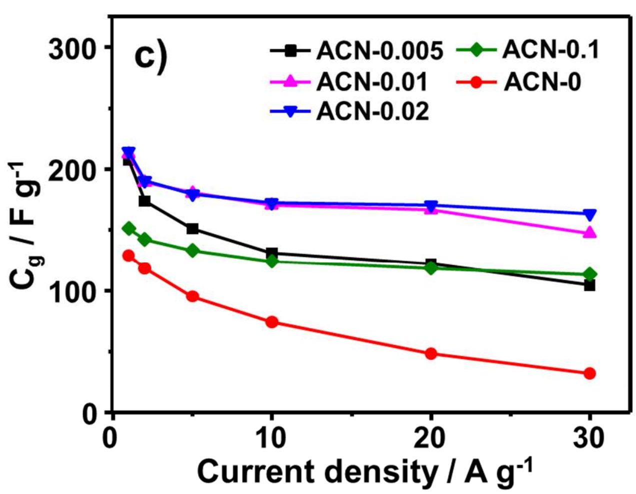

Figure S10. Specific gravimetric capacitance of ACNs at various current densities from 1 to 30 A g^{-1}.

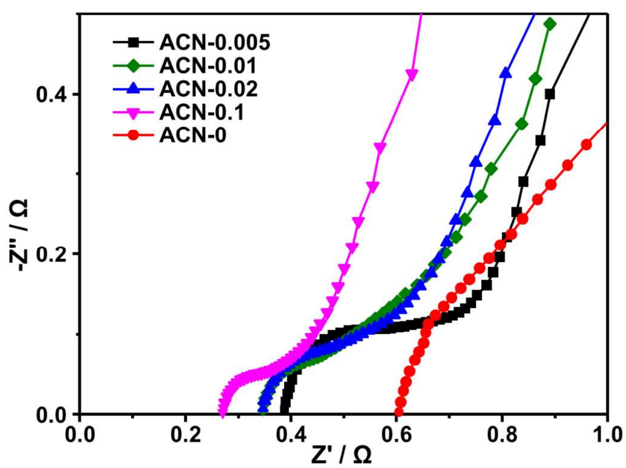

Figure S11. Nyquist plots of ACNs in three-electrode system.

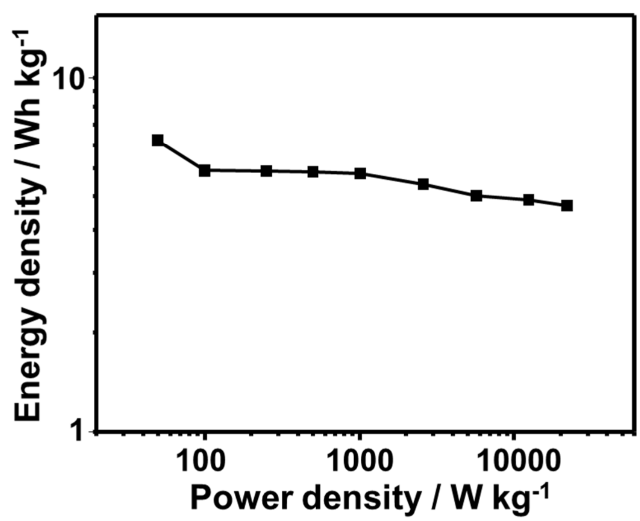

Figure S12. Ragone plot of ACN based supercapacitor in term of electrode active material weight.

Table S1

The capacitance of reported carbon nanosheet and commercial active carbon electrodes in three-electrode system.

Material	Electrolyte	Capacitance/F g^{-1}	Ref.
Asphaltene derived carbon nanosheet	6 M KOH	214 (1 Ag^{-1}), 163 (30 Ag^{-1})	This work
Mesoporous carbon thin films	6 M KOH	136 (0.5 Ag^{-1}), 85 (5 Ag^{-1})	[1]
Ionic liquid based Microporous carbon sheet	6 M KOH	213 (0.5 Ag^{-1}), 160 (10 Ag^{-1})	[2]
Mesoporous carbon/graphite nanosheet	6 M KOH	203 (1 Ag^{-1}), 132 (10 Ag^{-1})	[3]
Graphene-based macro- and mesoporous frameworks	1 M H_2SO_4	226 (1 mVs^{-1}), 83 (100 mVs^{-1})	[4]
Graphene oxide assisted carbon sheet	5 M KOH	140 (1 Ag^{-1})	[5]
Coal tar pitch based mesoporous carbon sheet	1 M Na_2SO_4	276.5 (1 Ag^{-1}), 82 (20 Ag^{-1})	[6]
Commercial active carbon (YP50)	6 M KOH	76 (1 mVs^{-1})	[7]

References

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