Electronic Supplementary Material (ESI) for RSC Advances

Supplementary Information

Rational synthesis of novel π-conjugated poly(1,5-diaminoanthraquinone) for high-performance supercapacitors

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Experimental section

Methylene blue technique for specific surface area measurement

Methylene blue (MB) is a common dye probe used to evaluate the specific surface area (SSA). The specific surface area was measured using MB adsorption method by UV-Vis spectroscopy.[1-4] The test was taken by first adding a known mass of sample into a known volume MB solution of standard concentration. The mixed suspension was then sonicated for 2 h and stirred continuously for 24 h to reach the adsorption-desorption equilibrium of MB. The mixture was further centrifuged to remove any suspended material. The MB concentration was subsequently determined by analyzing the supernatant through UV-vis spectroscopy at a wavelength of 665 nm compared with the initial standard concentration. The value of specific surface area can be calculated from the amount of adsorbed MB according to the following equation:

$$SSA = \frac{N_A A_{MB}}{M_{MB}} \frac{(C_0 - C_e)V}{m_S}$$

where N_A is Avogadro number (6.02×10^{23}/mol), A_{MB} is the covered area of per MB molecule (typically assumed to be 1.35 nm^2), C_0 and C_e are the initial and equilibrium concentrations of MB, respectively, V is the volume of MB solution, M_{MB} is the relative molecular mass of MB, and m_S is the mass of the sample.

Results and discussion

Table S1 Synthesis condition, polymerization yield and conductivity of PDAAs with various oxidants.

Oxidants	Redox potential (V)	DAA/oxidant molar ratio	Yield of PDAA (%)	Conductivity (S cm^{-1})
$(NH_4)_2S_2O_8$	2.05	1/1	/	/
H_2O_2	1.77	1/1	/	/
$KMnO_4$	1.51	5/2	19.7	2.10×10^{-7}
$Ce(SO_4)_2$	1.44	1/2	25.5	1.15×10^{-3}
CrO_3	1.35	3/2	7.0	8.05×10^{-6}
$FeCl_3$	0.77	1/2	/	/

Synthesis conditions: polymerization temperature = 20°C; DAA molar concentration = 0.017 M; reaction solution: 1 M H_2SO_4 in DMAc.

Table S2 Synthesis condition, yield, conductivity and specific surface area of PDAAs with various polymerization temperatures.

Samples	Temperature (°C)	Yield of PDAA (%)	Conductivity (S cm^{-1})	Specific surface area (m^2 g^{-1})
PDAA-0	0	14.8	$<10^{-8}$	71.8
PDAA-20	20	25.5	1.15×10^{-3}	86.3
PDAA-40	40	21.4	6.76×10^{-5}	67.6
PDAA-60	60	16.9	6.12×10^{-5}	60.8

Synthesis conditions: DAA/$Ce(SO_4)_2$ molar ratio = 2; DAA molar concentration = 0.017 M; reaction solution: 1 M H_2SO_4 in DMAc.

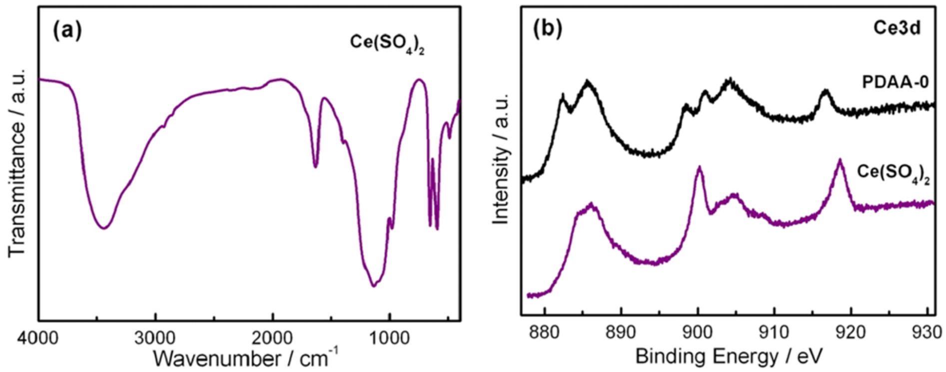

Fig. S1 (a) FTIR spectrum for the oxidant of $Ce(SO_4)_2$, (b) XPS spectra for the Ce 3d region of PDAA-0 and $Ce(SO_4)_2$.

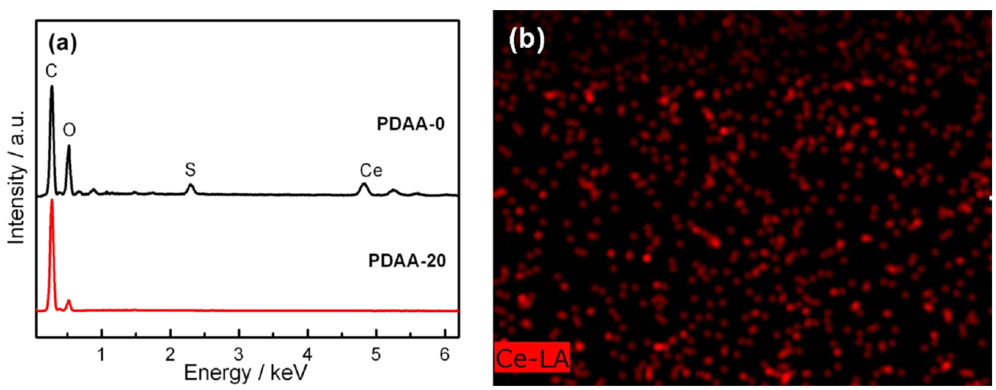

Fig. S2 (a) EDS of PDAA-0 and PDAA-20, (b) EDS cerium mapping of PDAA-0.

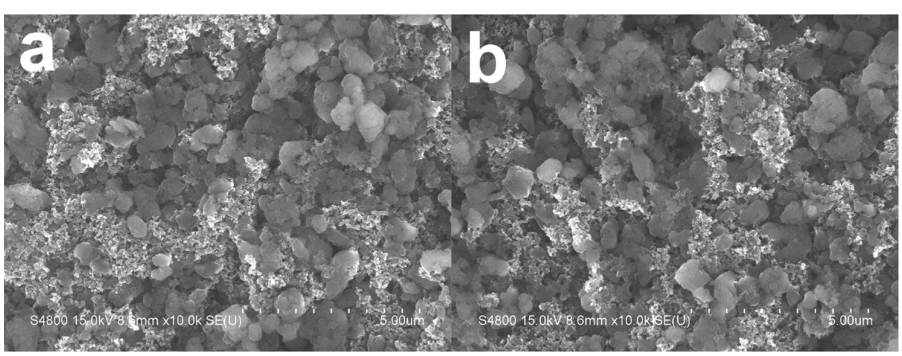

Fig. S3 FE-SEM images of PDAA-20 electrode wafer (a) before and (b) after 20000 cycles.

References

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