

A dataset of conducting polymers synthesized by electropolymerization for electrochemical energy storage in aqueous electrolytes

ZHU Bo¹, LU Xinyu², WANG Chao^{2,*}

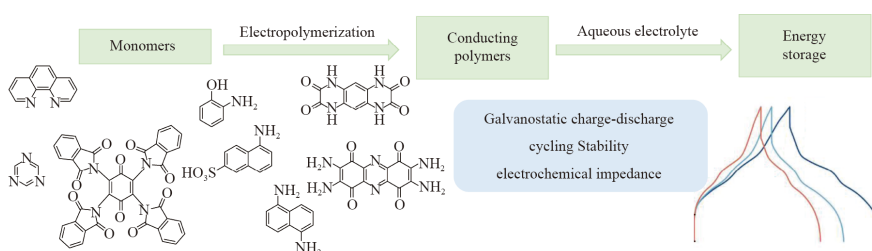
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Abstract: Conducting polymers are promising candidates for aqueous ion batteries, owing to their high conductivity, environmental friendliness, and flexibility. Electropolymerization

offers a facile route to construct conducting polymers at the surface of conductive substrates with controlled loading, morphology and structure. This dataset compares the electrochemical energy storage performance of some conducting polymers in aqueous electrolytes. Monomers to construct conducting polymers involve 1,10-phenanthroline, 5-amino-2-naphthalenesulfonic acid, *o*-aminophenol, 1,5-diaminonaphthalene, *s*-triazine, and some aromatic molecules with multiple carbonyl and imino groups. The electrolytes used to investigate the charge storage performance of these conducting polymers include aqueous sulfuric acid, zinc sulfate, ammonium sulfate, potassium hydroxide, and zinc trifluoromethanesulfonate solutions. Galvanostatic charge-discharge method at various active material mass-normalized current densities is used to evaluate the specific capacities of these conducting polymers. The total volume of this dataset is 266 MB with 490 files. This dataset can serve as the reference for the future design of electrode materials for electrochemical energy storage devices including aqueous ion batteries and supercapacitors.

Key words: conducting polymer; electropolymerization; aqueous electrolyte; aromatic molecules



Electrochemical energy storage devices are essential for a sustainable society depending on renewable energy sources. Conducting polymers feature high electron conductivity, structural tunability, flexibility, environmental benignity, and good processability, and are considered as promising candidates as the electrode materials for electrochemical energy storage devices^[1]. As the electrode materials for energy storage, conducting polymers can store charge through double-layer capacitance at the conducting polymer/electrolyte interface, and through the redox processes of the functional groups including amino/imino groups and hydroxyl/carbonyl groups in the structure. Besides, designing suitable functional groups to participate in the redox processes or to interact with ions in the electrolyte is a distinct advantage of conducting polymers

compared to other types of electrode materials such as metal oxides and carbonaceous materials^[2]. However, the specific capacity and cycling stability of conducting polymers are lower compared to metal oxides^[3]. Therefore, designing conducting polymers with novel structure is essential in improving their charge storage performance.

Electropolymerization is a powerful tool to construct conducting polymers at the surface of conductive substrates^[4]. During electropolymerization, an external potential is applied to the electrolyte containing monomers, and radicals are generated at the electrode/electrolyte interface. The radicals can couple with another monomer or radical to form an oligomer. Repetitive generation of radicals and oligomers forms conducting polymers that are deposited at the electrode surface. As the rate of radical

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generation is closely related to the electrochemical method, the rate of polymer growth can be precisely controlled by the potential, current or other electrochemical parameters applied during electropolymerization. Till now, only molecules with aromatic rings can efficiently produce radicals and be electropolymerized.

This dataset reports the charge storage performance of several conducting polymers synthesized by electropolymerization of aromatic molecules including 1,10-phenanthroline, 5-amino-2-naphthalenesulfonic acid, *o*-aminophenol, 1,5-diaminonaphthalene, *s*-triazine and some aromatic molecules with multiple carbonyl and imino groups (Figure 1). The data reported in this dataset can serve as the reference for the future design of conducting polymer electrode materials by electropolymerization or other methods.

1 Main part

1.1 Data profile

Table 1 systematically summarizes the basic information of the dataset of conducting polymers synthesized by electropolymerization for aqueous electrochemical energy storage, covering author's information, data description, generation time, file formats, and access sources.

1.2 Data value

The demand for energy storage devices with high safety

Table 1 Specifications of the dataset

Data title (V0.1)	A dataset of conducting polymers synthesized by electropolymerization for electrochemical energy storage in aqueous electrolytes
Author's name	ZHU Bo, LU Xinyu, WANG Chao
Corresponding author's name	WANG Chao
Data content description	This dataset contains the experimental results of a series of conducting polymers prepared by electropolymerization of aromatic molecules for the electrochemical energy storage in aqueous electrolytes. Galvanostatic and potentiostatic methods are adopted during electropolymerization. The energy storage performance of these conducting polymers is evaluated using galvanostatic charge-discharge (GCD) method at different active material mass-normalized current densities (1, 2, 3, 5 and 10 A/g) in the potential window where no significant electrolyte decomposition happens. Three-electrode setup at room temperature is adopted, and the reference electrode is a saturated calomel electrode. The counter electrode is a graphite rod. The electrolyte is 1 mol/L H ₂ SO ₄ , 1 mol/L or 2 mol/L ZnSO ₄ , 1 mol/L (NH ₄) ₂ SO ₄ , 1 mol/L KOH, or 2 mol/L Zn(CF ₃ SO ₃) ₂ . The experimental results of the cyclic voltammetry (CV) and impedance spectroscopy of some conducting polymers are also included.
Data generation time	2022–2025
Data volume	266 MB
Data format	.csv, .bin, .txt, .opj, .par, .psbd, .xlsx
Data source location	https://doi.org/10.57760/sciencedb.33244 https://cstr.cn/31253.11.sciencedb.33244
Citation format of data	ZHU Bo, LU Xinyu, WANG Chao. A dataset of conducting polymers synthesized by electropolymerization for electrochemical energy storage in aqueous electrolytes[J]. J Fuel Chem Technol, 2026, 54(7): 20250399. WANG Chao. A dataset of conducting polymers synthesized by electropolymerization for electrochemical energy storage in aqueous electrolytes[DS/OL]. https://doi.org/10.57760/sciencedb.33244 . DOI:10.57760/sciencedb.33244.

accelerates the research on the electrode materials that can store charge in aqueous electrolytes. The data provided in this dataset forms a good comparison regarding the conducting polymers for the electrochemical energy storage in aqueous electrolytes. Note that the conducting polymers are constructed with novel monomers (Figure 1) rather than the well-known monomers like aniline, thiophene, pyrrole, etc. Therefore, this dataset focuses on the conducting polymers with novel structures, and investigates the influence of active mass loading and monomer structure on the charge storage performance (specific capacity, rate capability and cycling stability, Table 2).

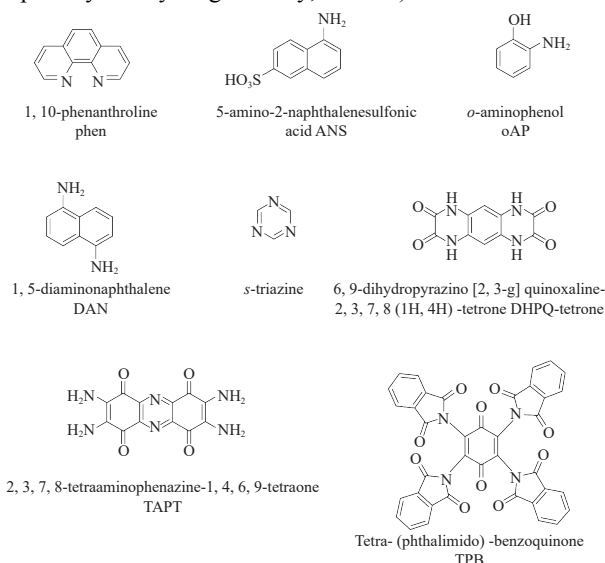


Fig. 1 The structure of monomers used to construct polymers in this dataset

Table 2 The electrochemical energy storage properties of conducting polymers synthesized by electropolymerization

	Monomer	Loading ₂ /(mg·cm ⁻²)	Electrolyte *	C _s /(mA·h·g ⁻¹)					C _s Retention /%	∂/Ω·s ^{-1/2} ·rad ^{1/2}
				1/(A·g ⁻¹)	2/(A·g ⁻¹)	3/(A·g ⁻¹)	5/(A·g ⁻¹)	10/(A·g ⁻¹)		
1	Phen	1.2	1 M H ₂ SO ₄	91.1	70.5	62.9	57.3	53.4	—	4.0
2	Phen	1.8	1 M H ₂ SO ₄	111.5	88.9	81.9	77.8	69.4	81.6	2.2
3	Phen	3.6	1 M H ₂ SO ₄	103.2	87.2	80.0	76.7	67.8	—	1.1
4	Phen	5.0	1 M H ₂ SO ₄	93.8	77.7	69.8	59.6	44.7	—	0.4
5	Phen	1.8	1 M H ₂ SO ₄	95.8	84.2	76.5	65.5	69.7	—	0.8
6	Phen	1.8	1 M H ₂ SO ₄	62.7	51.4	45.2	39.2	26.5	—	1.6
7	Phen	1.2	1 M KOH	138.0	70.8	54.9	49.5	38.6	—	5.6
8	Phen	1.8	1 M KOH	91.7	87.2	82.9	78.1	73.5	75.4	3.0
9	Phen	3.6	1 M KOH	73.1	54.6	50.4	44.2	34.0	—	1.4
10	Phen	5.0	1 M KOH	67.8	50.7	34.5	17.8	3.8	—	0.9
11	Phen	1.8	1 M KOH	54.6	48.0	45.6	40.1	34.7	—	4.3
12	Phen	1.8	1 M KOH	41.2	30.4	28.2	24.0	10.5	—	6.4
13	Phen	1.2	1 M Na ₂ SO ₄	23.9	21.5	19.1	16.8	13.6	—	—
14	Phen	1.8	1 M Na ₂ SO ₄	44.7	39.6	35.1	29.9	21.6	69.1	—
15	Phen	3.6	1 M Na ₂ SO ₄	33.3	23.2	18.5	13.0	6.3	—	—
16	Phen	5.0	1 M Na ₂ SO ₄	11.7	5.81	3.68	1.76	0.2	—	—
17	ANS	0.7	1 M H ₂ SO ₄	34.6	28.1	25.9	20.9	17.7	—	3.8
18	ANS	1.4	1 M H ₂ SO ₄	85.5	72.9	68.6	64.7	60.6	79.9	2.3
19	ANS	2.0	1 M H ₂ SO ₄	66.5	54.6	44.8	38.5	28.7	—	1.1
20	ANS	1.4	1 M ZnSO ₄	44.8	37.8	34.7	31.1	24.4	93.9	—
21	ANS	1.4	1 M (NH ₄) ₂ SO ₄	38.5	28.2	26.7	24.6	21.7	77.4	—
22	ANS	1.2	1 M H ₂ SO ₄	75.6	67.2	63.6	60.0	56.2	73.9	1.3
23	ANS+oAP	0.8	1 M H ₂ SO ₄	103.2	93.2	90.4	87.6	84.4	84.0	0.9
24	oAP	0.7	1 M H ₂ SO ₄	60.8	58.4	56.0	54.4	51.6	80.5	5.6
25	ANS	1.2	1 M ZnSO ₄	39.6	36.0	34.2	32.8	29.6	72.9	0.4
26	ANS+oAP	0.8	1 M ZnSO ₄	80.0	72.8	70.7	68.0	64.3	80.5	0.3
27	oAP	0.7	1 M ZnSO ₄	58.9	51.7	48.1	45.5	42.3	69.7	0.4
28	DAN	0.4	1 M H ₂ SO ₄	52.5	47.6	45.5	43.1	39.8	—	—
29	DAN	0.7	1 M H ₂ SO ₄	57.6	51.6	49.5	46.4	41.6	81.7	—
30	DAN	1.5	1 M H ₂ SO ₄	28.3	25.5	23.4	21.0	17.7	—	—
31	Triazine	0.2	1 M H ₂ SO ₄	90.5	70.2	62.5	61.8	54.5	—	134.1
32	Triazine	0.4	1 M H ₂ SO ₄	101.3	83.5	77.7	75.1	67.8	93.3	77.2
33	Triazine	0.6	1 M H ₂ SO ₄	70.8	58.8	53.0	50.4	46.9	—	76.0
34	Triazine	0.2	1 M ZnSO ₄	50.2	46.2	43.9	40.8	33.6	—	76.3
35	Triazine	0.4	1 M ZnSO ₄	57.6	49.3	46.3	40.5	31.1	85.5	34.5
36	Triazine	0.6	1 M ZnSO ₄	45.4	39.0	33.8	28.5	22.9	—	24.4
37	Triazine	0.4	1 M H ₂ SO ₄	83.1	58.4	52.6	47.9	39.4	88.4	70.2
38	Triazine+oAP	1.0	1 M H ₂ SO ₄	101.0	86.5	79.8	71.6	61.7	90.3	40.1
39	oAP	0.3	1 M H ₂ SO ₄	61.3	49.7	44.9	39.6	31.6	77.5	23.2
40	Triazine	0.4	1 M ZnSO ₄	46.2	37.6	32.9	25.2	17.4	86.3	20.8
41	Triazine+oAP	1.0	1 M ZnSO ₄	74.9	62.3	55.9	47.3	29.4	88.1	26.0
42	oAP	0.3	1 M ZnSO ₄	35.6	28.7	26.3	21.7	14.7	77.1	15.1
43	DHPQ-Tetrone	0.2	2 M Zn(CF ₃ SO ₃) ₂	66.5	63.9	64.4	61.9	56.6	—	160.0
44	DHPQ-Tetrone	0.4	2 M Zn(CF ₃ SO ₃) ₂	152.1	146.8	141.5	136.2	130.8	82.8	137.7
45	DHPQ-Tetrone	0.7	2 M Zn(CF ₃ SO ₃) ₂	152.3	144.1	138.8	124.8	110.9	—	204.7
46	TPB	0.2	2 M Zn(CF ₃ SO ₃) ₂	105.4	99.6	96.4	93.2	87.3	—	51.4
47	TPB	0.4	2 M Zn(CF ₃ SO ₃) ₂	189.9	175.9	164.5	155.9	136.3	84.1	52.2
48	TPB	0.7	2 M Zn(CF ₃ SO ₃) ₂	159.8	151.3	145.4	142.3	133.7	—	76.6
49	TAPT	0.3	2 M ZnSO ₄	117.2	89.9	64.4	25.1	3.69	—	273.0
50	TAPT	0.7	2 M ZnSO ₄	196.3	190.6	182.9	177.3	167.7	91.9	45.5
51	TAPT	1.0	2 M ZnSO ₄	131.1	125.5	123.8	118.1	114.4	—	121.8

*: "M"—mol/L.

The conducting polymers are all synthesized using the electropolymerization method. Users can use the data to compare the specific capacity, rate performance, and cycling stability of the conducting polymer-based materials with different structures or with different loadings. The format of data includes .bin (original data file generated using CHI software), .opj (Origin project file), .txt (text file), .csv, .xlsx, (spreadsheet file), and .par, .psbd (original data file generated using PARSTAT software), which can be easily plotted to compare with users' experimental results. Through charge storage performance comparison, reasons for inferior or superior charge storage performance in aqueous electrolytes can be inferred to aid the design of novel conducting polymers for electrochemical energy storage.

1.3 Data generation method or process

The CHI660E and PARSTAT MC potentiostats are adopted to generate the experimental data, along with the

software developed by these companies. The as-acquired experimental data is stored in the format of .bin .par, or .psbd. Electropolymerization is carried out using the galvanostatic method or potentiostatic method. Table 3 summarizes the electropolymerization method for each sample. The electrolyte for electropolymerization usually contains 2–6 mmol/L monomer in aqueous H₂SO₄ or HClO₄. Three-electrode setup is used to carry out the electropolymerization, with a carbon paper or carbon cloth as the working electrode (1 cm² immersed in the electrolyte), a cleaned graphite rod as the counter electrode, and a saturated calomel electrode as the reference electrode. After the electropolymerization process is done, the working electrode is rinsed thoroughly with water and dried in air. The active material loading is acquired by weighing the working electrode before and after the electropolymerization using a laboratory balance, and the mass increase after electropolymerization is determined as the mass of the active material.

Table 3 The electropolymerization method for the synthesis of these conducting polymers

	Electrolyte*	Electropolymerization method	Specific method
1	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 10 min
2	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
3	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 40 min
4	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 60 min
5	0.5 M H ₃ PO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
6	0.5 M <i>p</i> -toluenesulfonic acid + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
7	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 10 min
8	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
9	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 40 min
10	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 60 min
11	0.5 M H ₃ PO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
12	0.5 M <i>p</i> -toluenesulfonic acid + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
13	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 10 min
14	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 20 min
15	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 40 min
16	0.5 M H ₂ SO ₄ + 6 mM Phen	Galvanostatic	0.05 A·cm ⁻² for 60 min
17	0.1 M HClO ₄ + 2 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 20 min
18	0.1 M HClO ₄ + 2 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 40 min
19	0.1 M HClO ₄ + 2 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 60 min
20	0.1 M HClO ₄ + 2 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 40 min
21	0.1 M HClO ₄ + 2 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 40 min
22	0.1 M HClO ₄ + 5 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 40 min
23	0.1 M HClO ₄ + 5 mM ANS + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 40 min
24	0.1 M HClO ₄ + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 40 min

Table 3 The electropolymerization method for the synthesis of these conducting polymers (Continued)

	Electrolyte*	Electropolymerization method	Specific method
25	0.1 M HClO ₄ + 5 mM ANS	Galvanostatic	0.01 A·cm ⁻² for 40 min
26	0.1 M HClO ₄ + 5 mM ANS + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 40 min
27	0.1 M HClO ₄ + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 40 min
28	Reline + 30 mM DAN + 10% H ₂ O	Potentiostatic	0.8 V vs. SCE for 5 min
29	Reline + 30 mM DAN + 10% H ₂ O	Potentiostatic	0.8 V vs. SCE for 10 min
30	Reline + 30 mM DAN + 10% H ₂ O	Potentiostatic	0.8 V vs. SCE for 20 min
31	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 10 min
32	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 20 min
33	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 30 min
34	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 10 min
35	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 20 min
36	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 30 min
37	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 15 min
38	1 M H ₂ SO ₄ + 5 mM Triazine + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 15 min
39	1 M H ₂ SO ₄ + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 15 min
40	1 M H ₂ SO ₄ + 5 mM Triazine	Galvanostatic	0.01 A·cm ⁻² for 15 min
41	1 M H ₂ SO ₄ + 5 mM Triazine + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 15 min
42	1 M H ₂ SO ₄ + 2 mM oAP	Galvanostatic	0.01 A·cm ⁻² for 15 min
43	0.1 M H ₂ SO ₄ + 5 mM DHPQ-Tetrone	Galvanostatic	0.02 A·cm ⁻² for 60 min
44	0.1 M H ₂ SO ₄ + 5 mM DHPQ-Tetrone	Galvanostatic	0.02 A·cm ⁻² for 120 min
45	0.1 M H ₂ SO ₄ + 5 mM DHPQ-Tetrone	Galvanostatic	0.02 A·cm ⁻² for 180 min
46	0.1 M H ₂ SO ₄ + 5 mM TPB	Galvanostatic	0.02 A·cm ⁻² for 60 min
47	0.1 M H ₂ SO ₄ + 5 mM TPB	Galvanostatic	0.02 A·cm ⁻² for 120 min
48	0.1 M H ₂ SO ₄ + 5 mM TPB	Galvanostatic	0.02 A·cm ⁻² for 180 min
49	0.1 M H ₂ SO ₄ + 5 mM TAPT	Galvanostatic	0.02 A·cm ⁻² for 60 min
50	0.1 M H ₂ SO ₄ + 5 mM TAPT	Galvanostatic	0.02 A·cm ⁻² for 120 min
51	0.1 M H ₂ SO ₄ + 5 mM TAPT	Galvanostatic	0.02 A·cm ⁻² for 180 min

*: "M"—mol/L.

The charge storage performance is evaluated using a three-electrode setup, with the electrode with conducting polymers as the working electrode, a cleaned graphite rod as the counter electrode, and a saturated calomel electrode as the reference electrode. The electrolytes used to evaluate the charge storage performance are 1 mol/L H₂SO₄, 1 mol/L or 2 mol/L ZnSO₄, 1 mol/L (NH₄)₂SO₄, 1 mol/L KOH, or 2 mol/L Zn(CF₃SO₃)₂. The energy storage performance is evaluated using GCD method at different active material mass-normalized current densities (1, 2, 3, 5 and 10 A/g) in the potential window where no significant electrolyte decomposition happens. Approximately 1 cm² of the working electrode is immersed in the electrolyte. The specific capacity (C_s , mAh/g) is calculated from the discharge branch of the GCD curve by Equation (1).

$$C_s = It/m \quad (1)$$

where I (mA) is the discharge current, t (h) is the discharge time, and m (g) is the mass of active material on the electrode. The electrochemical impedance spectroscopy is recorded in the frequency range of 10⁵ to 0.01 Hz under the potential amplitude of 5 mV at 0 V. The slope of Z' against the $\omega^{-0.5}$ (unit: rad^{-0.5}·s^{0.5}) gives the Warburg factor (ϑ), which is related to the impedance of ion diffusion.

1.4 Data sample description

The data provided in this database includes GCD, CV, C_s versus cycle number and electrochemical impedance data. For Samples 1–16, monomer used is Phen. Different loadings of polyPhen are achieved by altering the duration

of electropolymerization^[1]. Samples 5 and 11 are prepared by electropolymerization in H_3PO_4 , and consequently phosphate ions are likely intercalated into the polyPhen. Samples 6 and 12 are prepared by electrodeposition in *p*-toluenesulfonic acid, and *p*-toluenesulfonate ions are expected to be intercalated into the polyPhen. Samples 17–21 are synthesized using the monomer ANS with different electropolymerization durations^[2]. Samples 22–27 compare the copolymer synthesized with two monomers during electropolymerization with the homopolymers^[4]. Samples 28–30 are synthesized using monomer DAN with different electropolymerization durations^[3]. Samples 31–42 are synthesized based on *s*-triazine, and compare the electropolymerization duration and forming copolymer to the charge storage performance^[5–6]. Samples 43–51 deal with the electropolymerization of three aromatic molecules containing multiple carbonyl and amino groups^[7–8].

The electrolytes used to investigate the charge storage performance of these polymers can be divided into acidic, neutral and basic. Most of the conducting polymers are not stable in base, except for polyPhen. Therefore, data acquired in 1 mol/L KOH is provided only for polyPhen (Samples 7–12). For the acidic electrolyte, as the ions from the electrolyte can affect the charge storage performance, electrolytes with different cations are used including H^+ , Zn^{2+} and NH_4^+ . In some cases, the $\text{Zn}(\text{CF}_3\text{SO}_3)_2$ is selected. This is because that for Samples 43–48, higher charge storage performance is achieved in $\text{Zn}(\text{CF}_3\text{SO}_3)_2$ compared to ZnSO_4 . The exact reason for this phenomenon is unknown, and is probably resulted from the higher ionic conductivity, favorable solvation structure, and improved interfacial kinetics of the $\text{Zn}(\text{CF}_3\text{SO}_3)_2$ compared to those of ZnSO_4 electrolytes.

The electrochemical method used is mainly galvanostatic method at relatively large current densities. Due to the unique structure of these monomers, usually a high potential is required to generate radicals and to initiate the polymerization process. Also, the kinetics of polymerization process is slow, and using CV cannot generate significant amounts of polymers in a short period. Therefore, galvanostatic method is primarily used in synthesizing these polymers. From Table 2, some preliminary conclusions can be generated regarding the influence of electropolymerization method to charge storage properties. Short electropolymerization duration is insufficient to generate significant amounts of active sites, which leads to relatively low C_s . However, prolonged electropolymerization would generate significant amounts of polymers at the electrode surface, that limit the electron conductivity and ion diffusion, and subsequently entail inferior C_s . Therefore, an optimum galvanostatic polymerization duration exists, depending on the structure of the monomer.

In addition, the cycling stability of some of the conducting polymers is provided. Note that for a series of conducting polymers constructed using the same monomer, the cycling stability data is provided only for the sample with the highest C_s (Samples 2, 8, 14, 18, etc.). For the samples where no stability data is provided, inferior cycling stability

is implied.

Conducting polymers exhibit charge storage properties owing to the exposed specific surface area and redox active sites. As the electropolymerization often generates relatively thin and compact layer of conducting film at the electrode surface, the double layer capacitance contribution is small. Therefore, the amounts and the structure of redox active sites contribute to the C_s prevalently. By designing molecules with multiple redox active sites like carbonyl and amino groups, the C_s is expected to increase. This could account for the higher C_s of the polyTAPT, poly(DHPQ-Tetrone), and poly(TPB). For each of these monomers, maximum 8–10 electrons can be transferred from the fully reduced state to the fully oxidized state. Therefore, higher C_s is expected for polyTAPT, poly(DHPQ-Tetrone), and poly(TPB).

Comparison of some samples with literature reported electropolymerized conducting polymers is shown in Figure 2. The comparison is made using the recently reported GCD data at 1 A/g. Monomers used for electropolymerization include 3,4-ethylenedioxythiophene (EDOT)^[9], aniline^[10–11], 2,5-dihydroxy aniline^[12], 8-amino-2-naphthol^[13], menadione^[14], 2,7-diazopyrene-4,5,9,10-tetraone^[15], thionine^[16], DAN^[17], pyrrole^[18] and redox-active quinone-based porous organic polymer (rPOP)^[19]. The samples reported here are among the highest C_s reported to date.

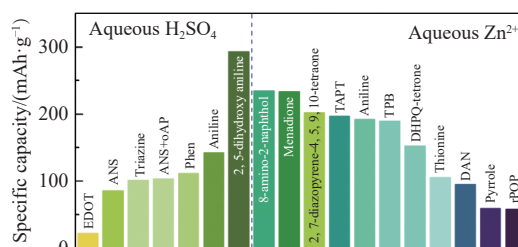


Fig. 2 Comparison of the C_s at 1 A/g of conducting polymers synthesized by electropolymerization

1.5 Data quality

To ensure the reliability and repeatability of sample preparation, all these samples are synthesized at least three times, and the electrochemical data is tested using different batches of samples. The results reported are the average specific capacities of the conducting polymers. Limited by the experimental errors of the electrochemical methods, all data exhibits less than 5% standard deviation. Besides, the optimum samples exhibit less than 3% standard deviation. The reference electrode potential is calibrated against a new saturated calomel electrode before and after each test.

1.6 Data usage methods and suggestion

It is recommended that when using these data, users should identify the synthetic method before making a fair comparison. All the conducting polymers reported in this dataset are synthesized using electropolymerization method,

that are strongly adherent to the surface of conductive substrate, and that are often dense and non-porous. Another important synthetic method of conducting polymers is the chemical polymerization, which can generate conducting polymer nanostructures with relatively high specific surface area, and which requires conductive additives and binders to attach to the substrate surface. Also, the loading of the active material should be taken into account when comparing these data. The C_s of the conducting polymers are weakly dependent on the loading till reaching a threshold (usually 4–5 mg/cm²), beyond which a dramatic decrease in C_s is observed, possibly caused by the poor conductivity of thick films. Besides, when comparing data generated from other sources, be careful about the test temperature, electrolyte, and the composition. The data provided in .bin and .par format is directly generated without any post-treatment.

2 Conclusion

A database of the electrochemical energy storage performance of a series of conducting polymers is constructed based on experimental results. The conducting polymers are synthesized using electropolymerization method from monomer-containing electrolytes. Key charge storage parameters can be acquired using the data provided, and are summarized. The influence of conducting polymer structure and electrolyte to the C_s can be inferred from this data set. Also, the rate capability and cycling stability of some conducting polymers are provided. This dataset forms a reference on the electrochemical charge storage in aqueous electrolytes of these conducting polymers with novel structures. This could aid the future design of conducting polymer electrode materials with high C_s and stability for aqueous ion storage.

Data availability statement

The data supporting the results in this study has been published in sciencedb database and can be obtained through DOI: [10.57760/sciencedb.33244].

Declaration of Competing Interest

The authors declare no conflict of interest.

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电化学聚合制备导电聚合物的水系储能性能数据集

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摘 要: 导电聚合物因其高导电性、环境友好性和柔韧性有望应用于水系离子电池。电化学聚合提供了一种在导电基底表面构建具有可控负载、形貌和结构的导电聚合物的便捷有效方法。本数据集比较了部分导电聚合物在水系电解质中的电化学储能性能。用于构建导电聚合物的单体包括 1,10-菲咯啉、5-氨基-2-萘磺酸、邻氨基苯酚、1,5-二氨基萘、均三嗪及含多羰基亚氨基的芳香分子。研究其储能性能所用的电解质包含硫酸、硫酸锌、硫酸铵、氢氧化钾和三氟甲烷磺酸锌水溶液。通过活性物质质量归一化电流密度的恒电流充放电法,评估了这些电聚合薄膜的比容量。本数据集总容量为 266 MB, 包含 490 个文件, 可为未来设计水系离子电池、超级电容器等电化学储能装置的电极材料提供参考。

关键词: 导电聚合物; 电化学聚合; 水系电解液; 芳香分子

中图分类号: O631.3

文献标识码: A

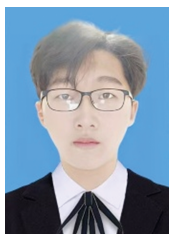
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