

Supporting Information

Mesoporous graphitic carbon nanodisks fabricated via catalytic carbonization of coordination polymers

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Experimental Section

Preparation of the iron-based CP nanodisks

CP-FeSO₄: 5 mL FeSO₄·7H₂O (0.05 mmol) aqueous solution was added to the aqueous solution of 1,4,5,8-naphthalenetetracarboxylic dianhydride (NTCDA) (0.025 mmol) dissolved in 25 mL NaOH solution (0.002 M). After stirring at room temperature for 30 min, the resulting mixture was transformed into Teflon-lined stainless steel sealed vessel and heated at 60 °C for 24 h. Subsequently, the precipitate was isolated by centrifugation and washed thoroughly with deionized water. The preparation of CP-FeCl₂ was in a similar method to CP-FeSO₄ with the exception that FeCl₂ was used as iron salt precursor.

Carbonization of the iron-based CP nanodisks

The iron-based CP nanodisks were calcined at 200 °C for 2 h and then the calcination temperature was raised to 900 °C or 700 °C and kept at this temperature for 4 h under N₂ atmosphere. The heating rate during the calcinations step was 5 °C/min. The carbonized products were denoted as Fe-C-S_x and Fe-C-Cl_x respectively using CP-FeSO₄ and CP-FeCl₂ as precursors, where x refers to the calcination temperature.

Preparation of mesoporous carbon materials

0.2 g Fe-C-S_x or Fe-C-Cl_x was dispersed in 50 mL HCl (2 M) solution and stirred at room temperature for 5 h. And then the carbon material was isolated by centrifugation and washed thoroughly with deionized water. Subsequently it was dried at 100 °C for 24 h. The obtained carbon materials were labeled as C-S_x and C-Cl_x respectively using CP-FeSO₄ and CP-FeCl₂ as precursors, where x refers to the calcination

temperature.

Characterization

The FT-IR spectra were recorded using KBr discs on a Nicolet Impact 410 spectrophotometer in the range 4000-400 cm^{-1} . The scanning electron microscopy (SEM) was undertaken on JEOL JSM-6360 scanning electron microscope operating at an acceleration voltage of 20 kV. The transmission electron microscopy (TEM) was performed using an FEI Tecnai G² Spirit at an acceleration voltage of 120 kV. The samples were placed onto an ultrathin carbon film supported on a copper grid. The powder X-ray diffraction data were collected on a Rigaku D/Max2500PC diffractometer with Cu K α radiation ($\lambda=1.5418 \text{ \AA}$) over the 2θ range of 5°-70° with a scan speed of 5°/min at room temperature. The thermogravimetric analysis (TGA) was performed under N₂ atmosphere with a heating rate of 5°C/min by using a NETZSCH STA-449F3 thermogravimetric analyzer. High resolution transmission electron microscopy (HRTEM) and STEM images were recorded on a FEI Tecnai F30 microscope with a point resolution of 0.20 nm operated at 300 kV. The nitrogen sorption experiments were performed at 77 K on a Micromeritics ASAP 2020 system. Prior to the measurement, the samples were degassed at 120 °C for 6 h. Visible Raman spectra were recorded at room temperature on a Jobin Yvon LabRAM HR 800 instrument with a 532 nm excitation laser at a power of around 1 mW.

Electrochemical measurements

Cyclic voltammetry experiments were carried out in a three-electrode system with an electrochemical workstation (CHI 700D, CH Instruments, Inc.). 6 M KOH aqueous

solution was used as electrolyte, mesoporous carbon materials as the working electrode, a platinum wire as the counter electrode and Ag/AgCl electrode as the reference electrode. The working electrodes were prepared by mixing the carbon materials with acetylene black (10 w.t.%) and polytetrafluoroethylene (PTFE, 5 w.t.%) and then pressing the plasticine like mixtures onto nickel foam that served as a current collector.

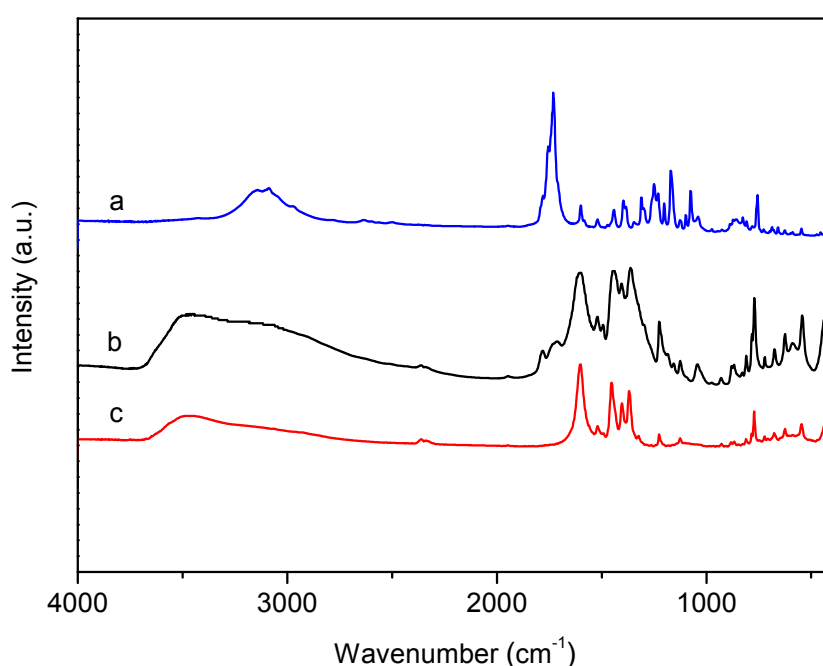


Fig. S1 The FT-IR spectra of (a) organic ligand, 1,4,5,8-naphthalenetetracarboxylic dianhydride (NTCDA), (b) CP-FeSO₄ and (c) CP-FeCl₂.

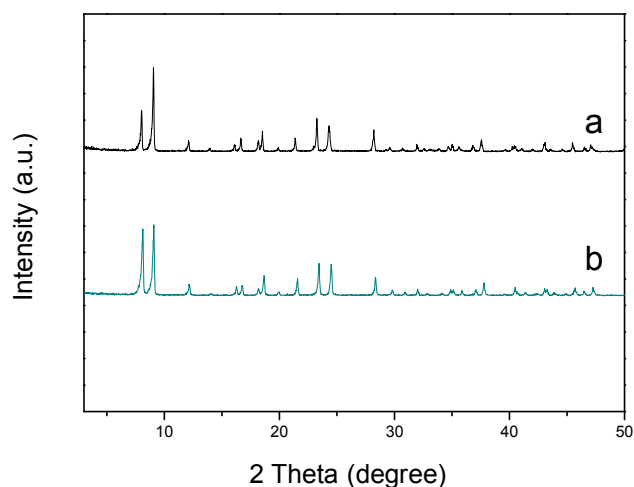


Fig. S2 The XRD patterns of (a) CP-FeSO₄ and (b) CP-FeCl₂.

Table S1 The textual parameters of Fe-based CPs and the carbon nanodisks and capacitance of the carbon nanodisks.

Sample	$S_{\text{BET}}^{\text{a}}$ (m^2/g)	V_{p}^{b} (cm^3/g)	$D_{\text{meso}}^{\text{c}}$ (nm)	$D_{\text{micro}}^{\text{d}}$ (nm)	$I_{\text{D}}/I_{\text{G}}^{\text{e}}$	C_{g}^{f} (F/g)	C_{s}^{g} (F/m ²)
CP-FeSO ₄	14.2	0.03					
CP-FeCl ₂	76.7	0.1					
C-S700	817	0.85	2.7, 10.6	0.8	3.1	182	0.22
C-S900	704	0.71	2.5, 9.5	0.8	3.0	156	0.22
C-CI700	311	0.5	2.6	1.2	2.6	117	0.38
C-CI900	199	0.4	2.6	1.2	2.5	70	0.35

^a the Brunauer-Emmett-Teller (BET) specific surface areas calculated from adsorption data in the relative pressure range of $P/P_0 = 0.05\sim 0.25$. ^b the total pore volume determined from the amounts adsorbed at the relative pressure of 0.99. ^c the mesopore size distribution calculated from the N₂ adsorption branch using the Barrett-Joyner-Halenda (BJH) method. ^d the micropore size distribution calculated using the Horvath-Kawazoe (HK) method. ^e the degree of graphitization calculated from the ratio of the D and Q peak intensity. ^f the specific capacitance calculated at -0.5V with scan rate of 2 mV/s. ^g the specific capacitance calculated at -0.5V using C_{g} and S_{BET} .

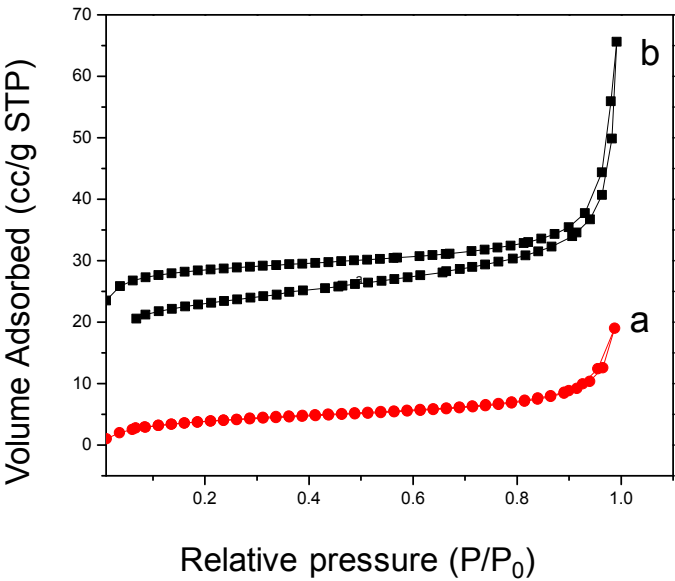


Fig. S3 The nitrogen adsorption-desorption isotherm for (a) CP-FeSO₄ and (b) CP-FeCl₂ particles.

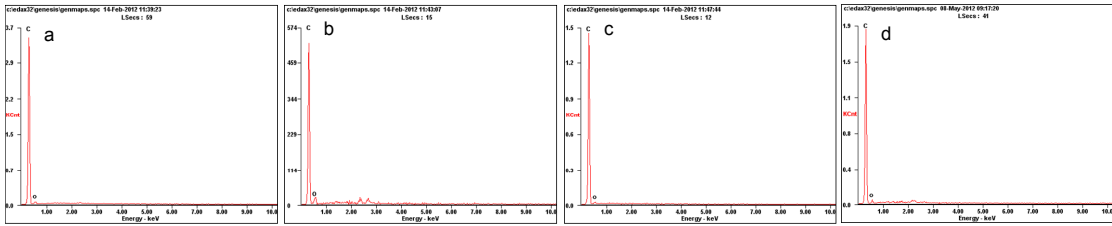


Fig. S4 The EDX results of different carbon materials: (a) C-S900, (b) C-S700, (c) C-CI900 and (d) C-CI700.

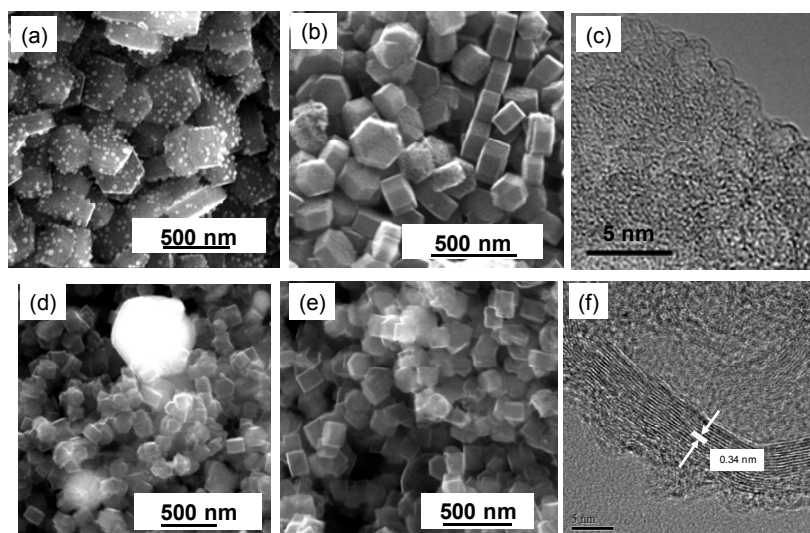


Fig. S5 The SEM images of the carbonization products (a) Fe-C-S700, (b) C-S700, (d) Fe-C-Cl700, (e) C-Cl700 and HRTEM images of (c) C-S700 and (f) C-Cl700.

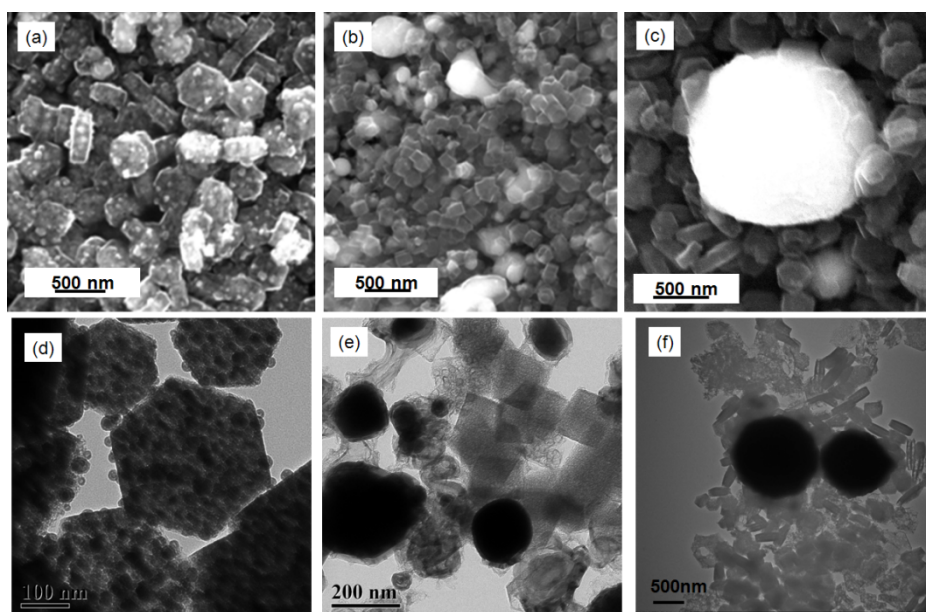


Fig. S6 The SEM images of (a) Fe-C-S900, (b) Fe-C-Cl900, (c) Fe-C-S900-NaCl; and TEM images of (d) Fe-C-S900, (e) Fe-C-Cl900 and (f) Fe-C-S900-NaCl (the large spheres in the image are the iron species particles).

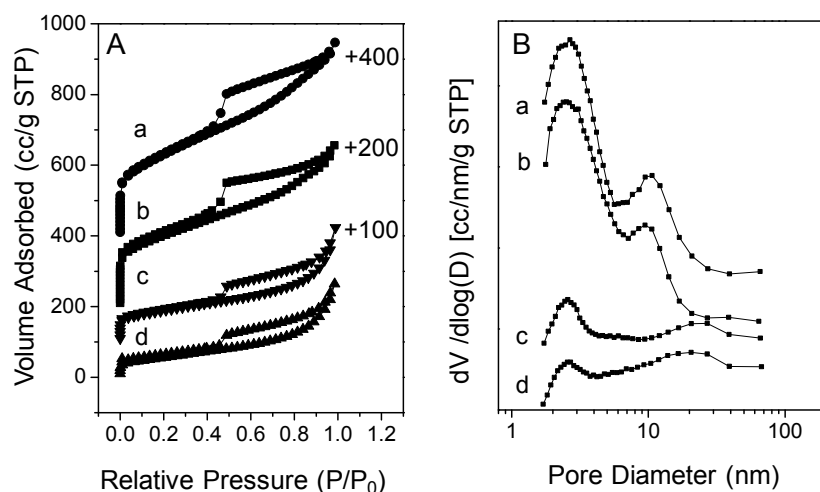


Fig. S7 (A) The nitrogen adsorption-desorption isotherms and (B) pore size distribution curves of (a) C-S700, (b) C-S900, (c) C-CI700 and (d) C-CI900.

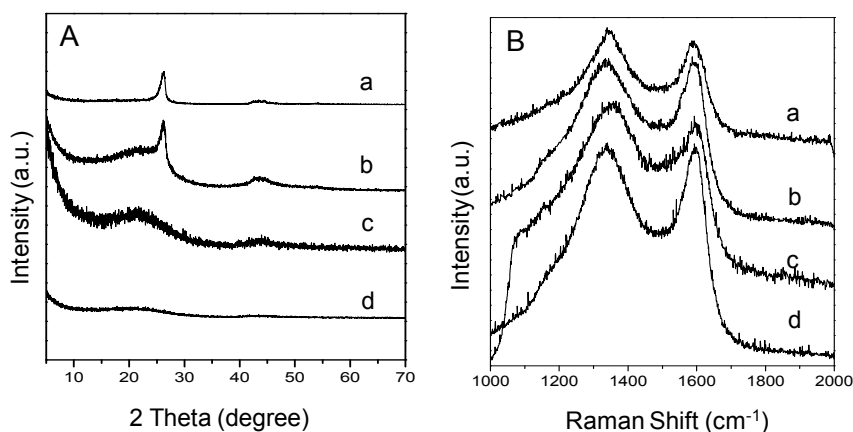


Fig. S8 (A) The XRD patterns and (B) Raman spectra of carbon nanodisks (a) C-CI900, (b) C-CI700, (c) C-S900 and (d) C-S700.

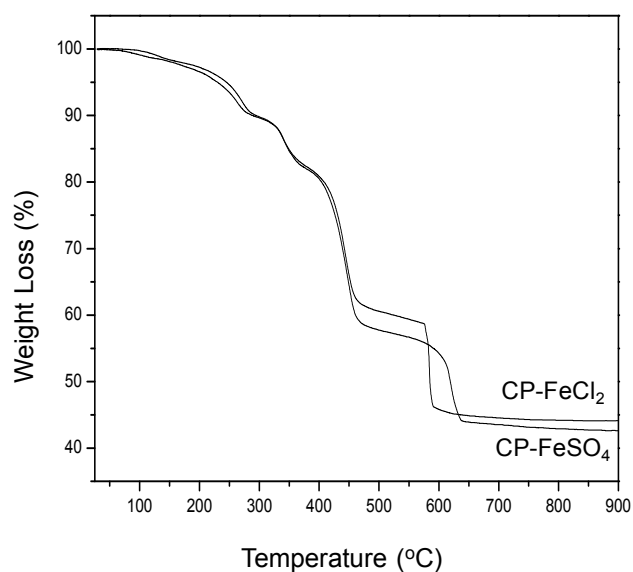


Fig. S9 The TGA curves of CP-FeSO₄ and CP-FeCl₂ nanodisks in N₂ atmosphere.

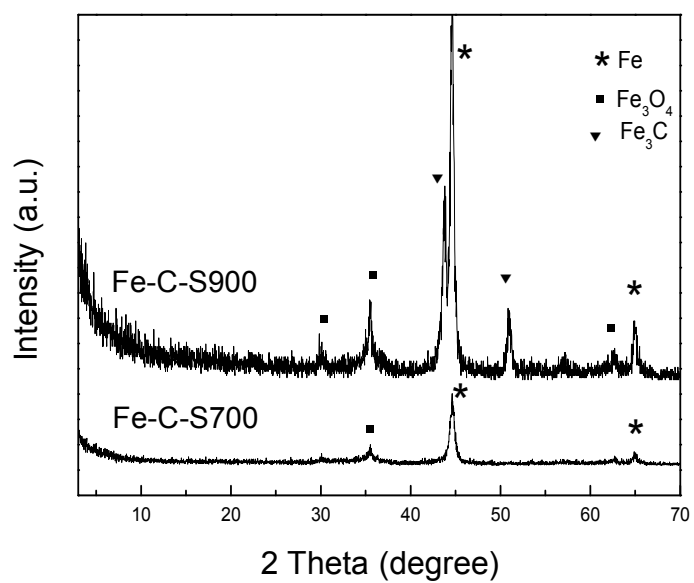


Fig. S10 The XRD patterns of the carbonization products: Fe-C-S900 and Fe-C-S700.

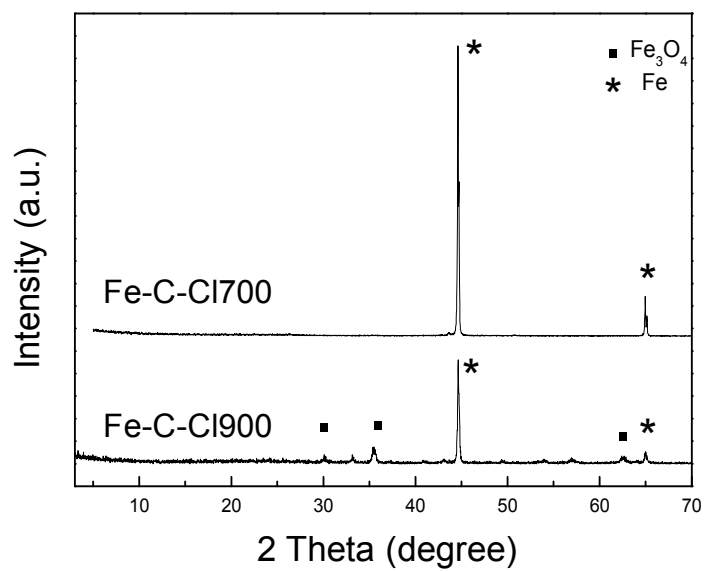


Fig. S11 The XRD patterns of the carbonization product: Fe-C-CI900 and Fe-C-CI700.

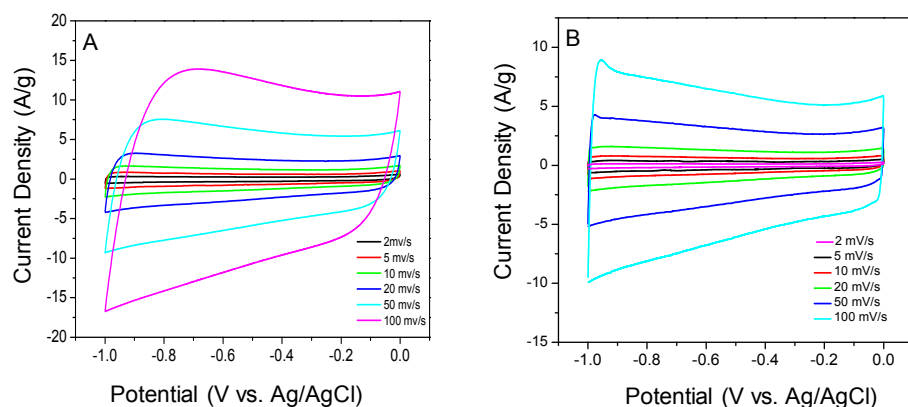


Fig. S12 Cyclic voltammograms of (A) C-S900 and (B) C-Cl900 electrodes at different scan rates in 6 M KOH electrolyte.

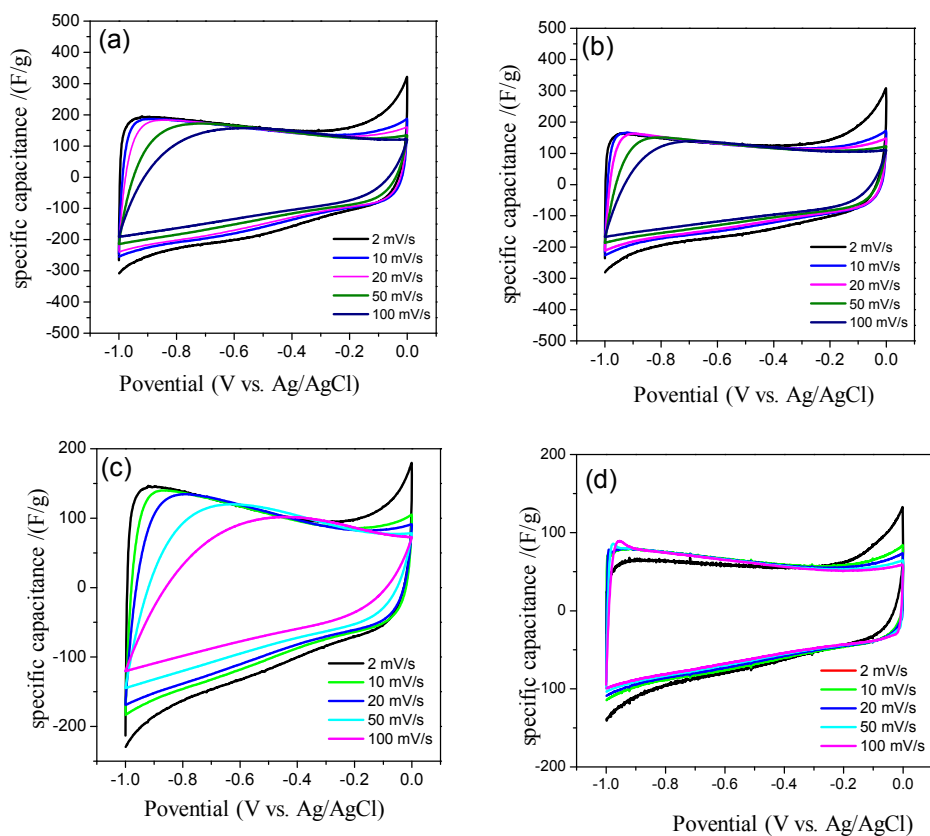


Fig. S13 Cyclic voltammograms of (a) C-S700, (b) C-S900, (c) C-Cl700 and (d) C-Cl900 electrodes at different scan rates in 6 M KOH electrolyte.

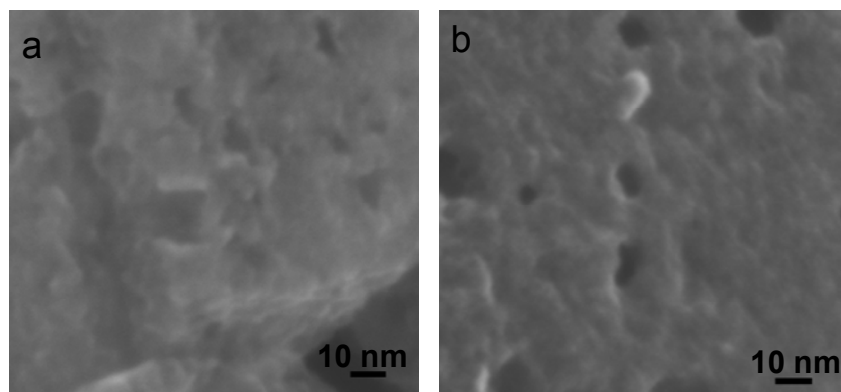


Fig. S14 HRSEM images of (a) C-S700 and (b) C-S900.

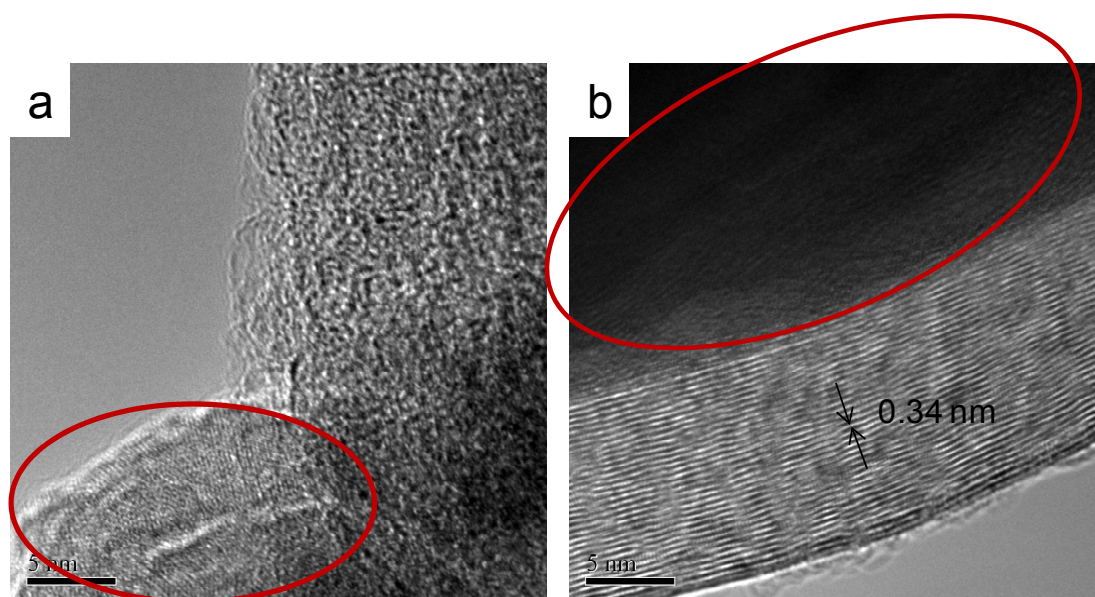


Fig. S15 HRTEM images of (a) Fe-C-S900 and (b) Fe-C-CI900 (the iron species were circled by red lines.).