Electronic Supplementary Information (ESI)

Rectangular Co_3O_4 with Micro-/nanoarchitectures: Charge-driven PDDA-assisted Synthesis and Excellent Lithium Storage Performance

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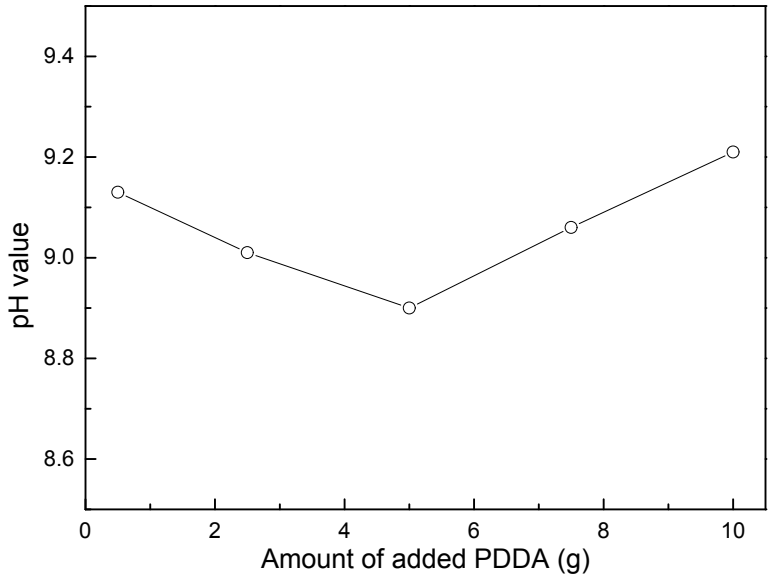

Fig.S1 Effects of added PDDA on the final pH of the reactant solution after hydrothermal treatment

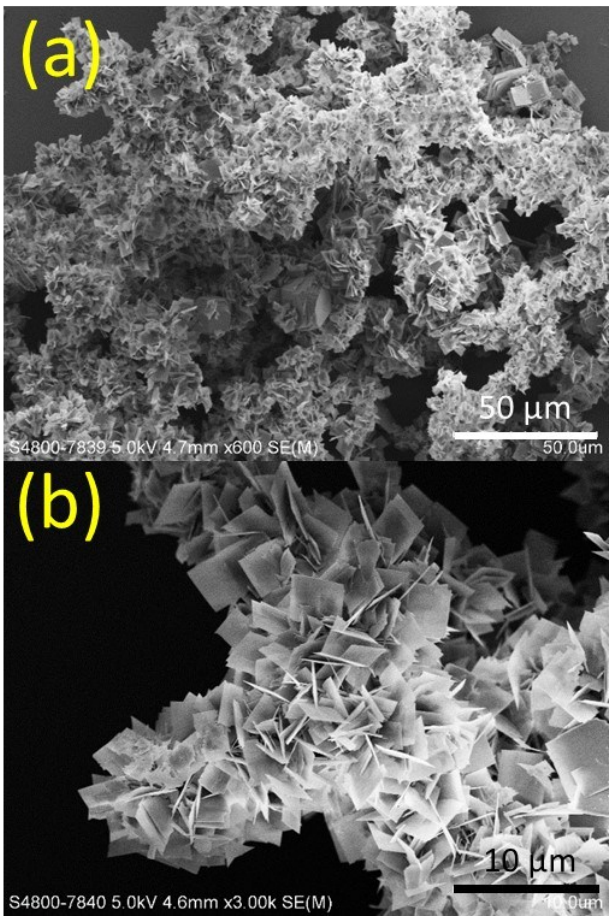

Fig.S2 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O + 0.5 g PDDA (MW: 200~350K); (a) magnification: × 600; (b) magnification: × 3000.

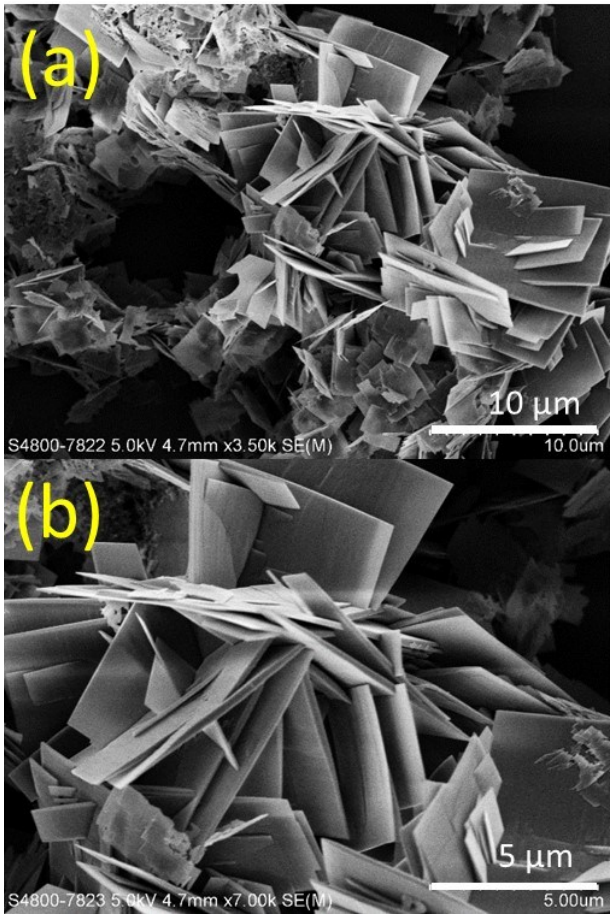

Fig.S3 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O + 2.5 g PDDA(MW: 200-350K); (a) magnification: × 3500; (b) magnification: × 7000.

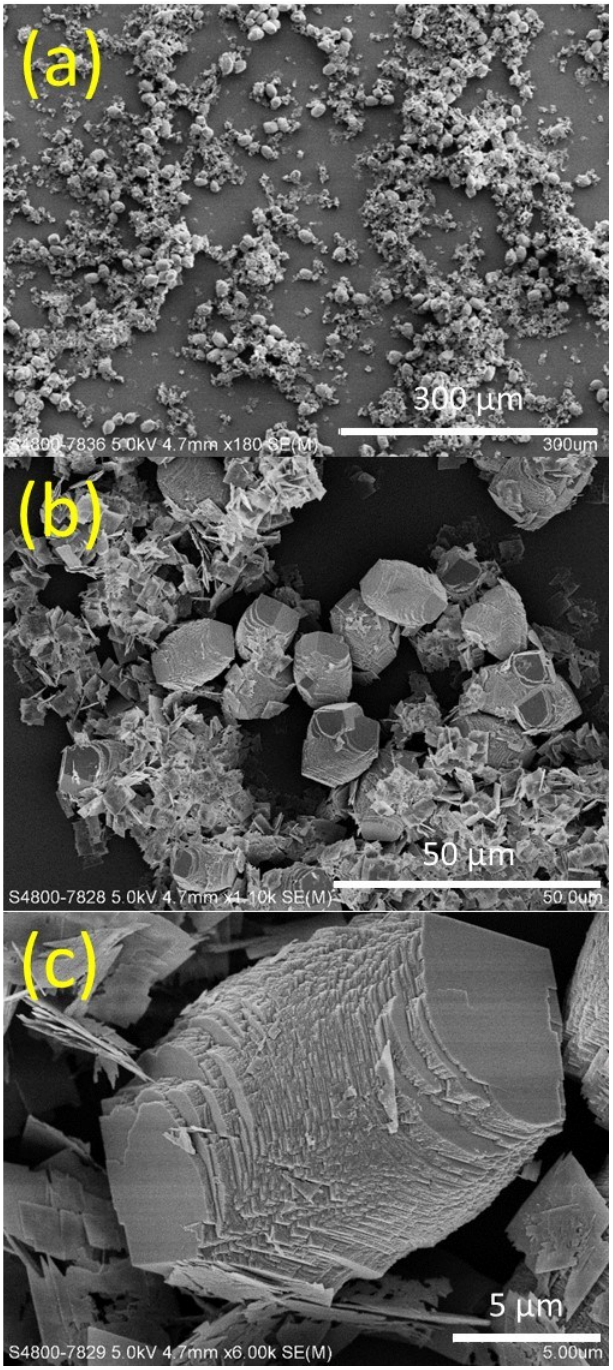

Fig.S4 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O + 7.5 g PDDA (MW: 200~350K); (a) magnification: × 180; (b) magnification: × 1100; (c) magnification: × 6000.

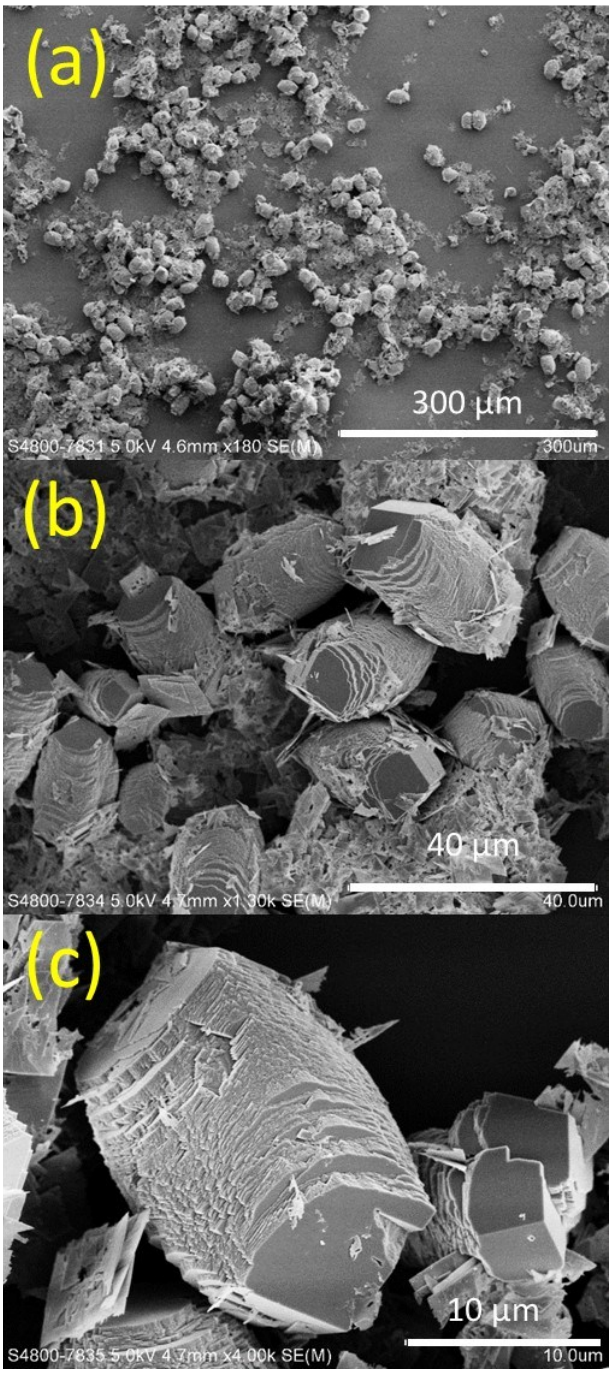

Fig.S5 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O + 10 g PDDA (MW: 200~350K); (a) magnification: × 180; (b) magnification: × 1300; (c) magnification: × 4000.

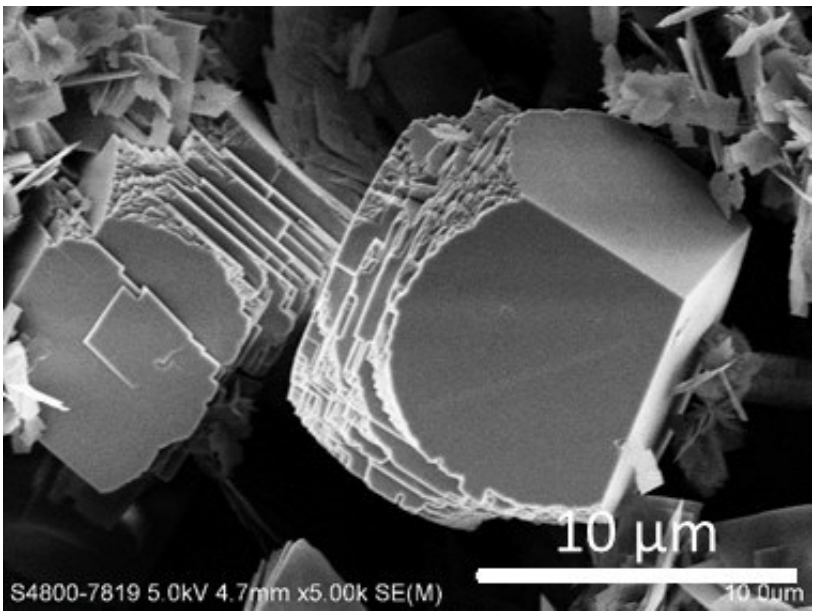

Fig.S6 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O; magnification: ×5000.

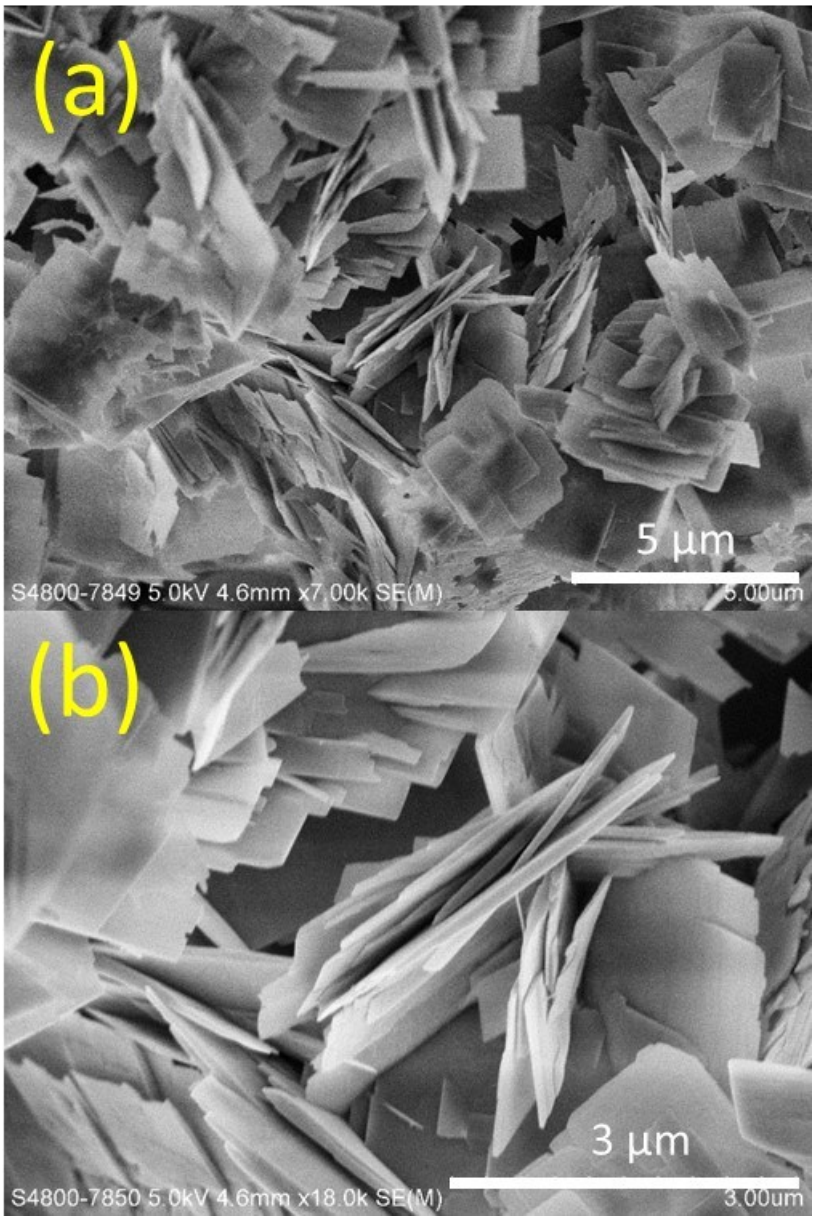

Fig.S7 Typical FE-SEM images of the as-prepared Co_3O_4 precursors with 1.25 g $Co(ac)_2$ + 3 g urea + 55 mL H_2O + 5 g PDDA (MW: 400-500 K); (a) magnification: × 7000; (b) magnification: × 18000.

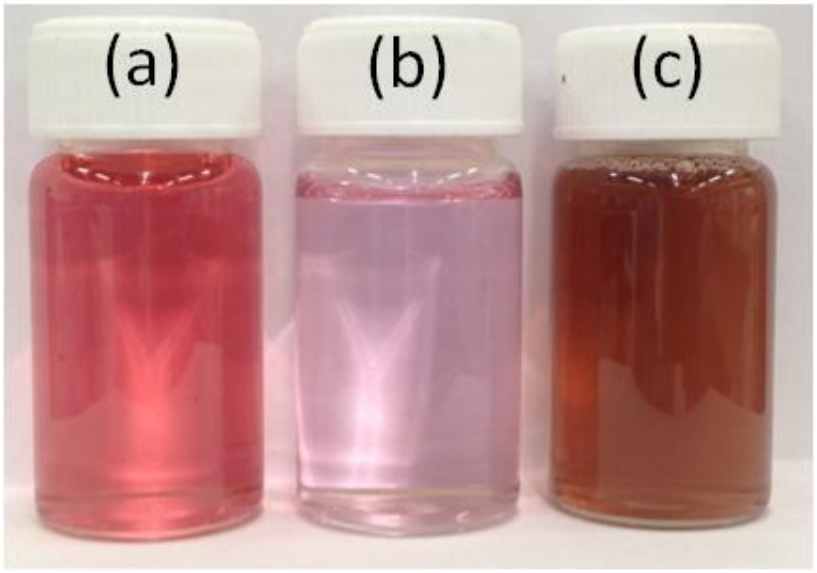

Fig. S8 Digital photos of typical hydrothermal reaction solutions (a) reaction solution having 1.25 g $Co(ac)_2$, 3 g urea and 5 g PDDA solution before hydrothermal treatment. The pink colour is from cobalt acetate used in the material synthesis; (b) reactant solution with the presence of 3 g urea after hydrothermal treatment. The light pink colour is due to the low concentration of cobalt ions; (c) reactant solution without the presence of urea after hydrothermal treatment. The obvious red colour is from cobalt ions, indicating that cobalt ions could not be precipitated if no urea was added in hydrothermal synthesis.

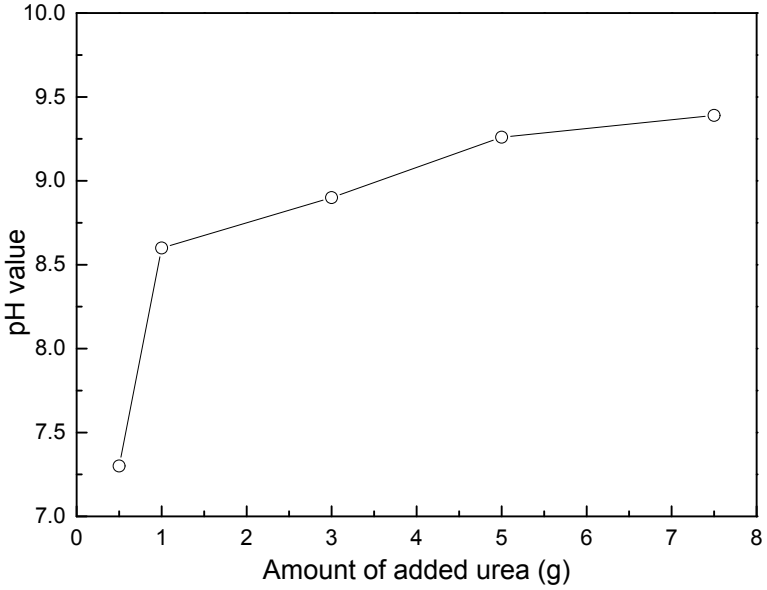

Fig.S9 Effects of added urea on the final pH of the reactant solution after hydrothermal treatment

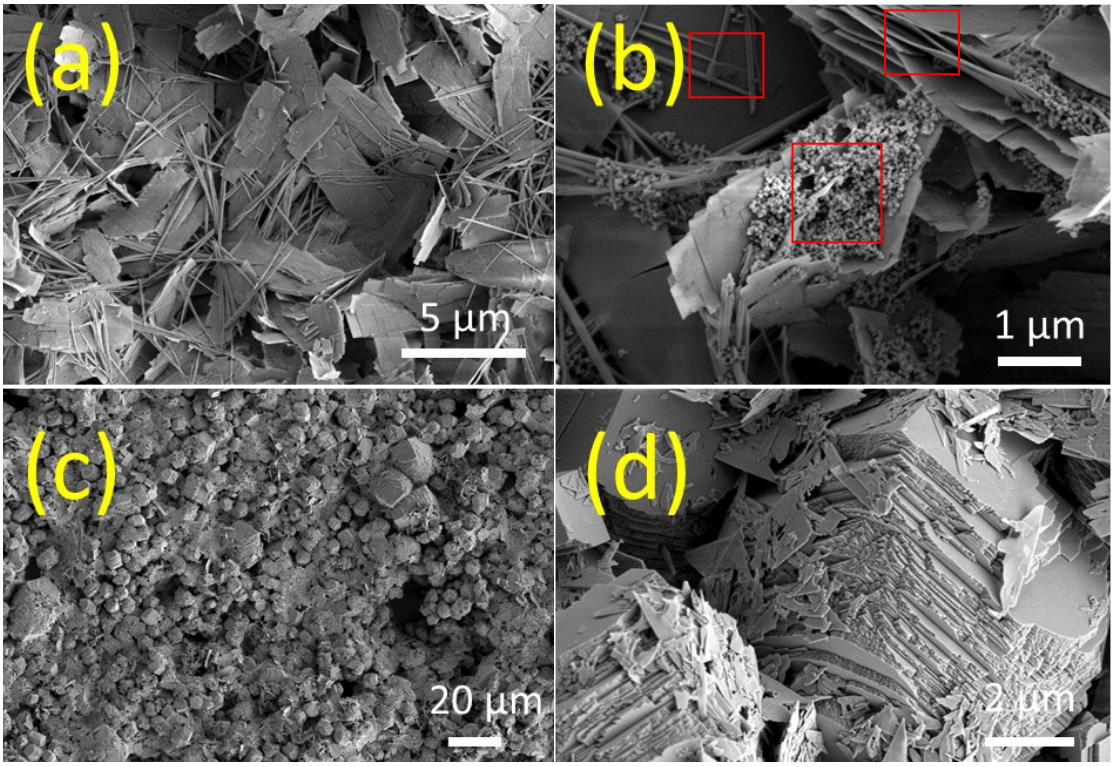

Fig S10 Typical FE-SEM images of Co_3O_4 precursors synthesized with 1.25 g $Co(ac)_2$, 5 g PDDA and different amounts of urea (a,b) 0.5 g urea, small nanoparticles, one dimensional nano-needles and two dimensional sheet-like structures can be found in the images; (c,d) 7.5 g urea, micron-sized materials with lamellar structure can be found in the images

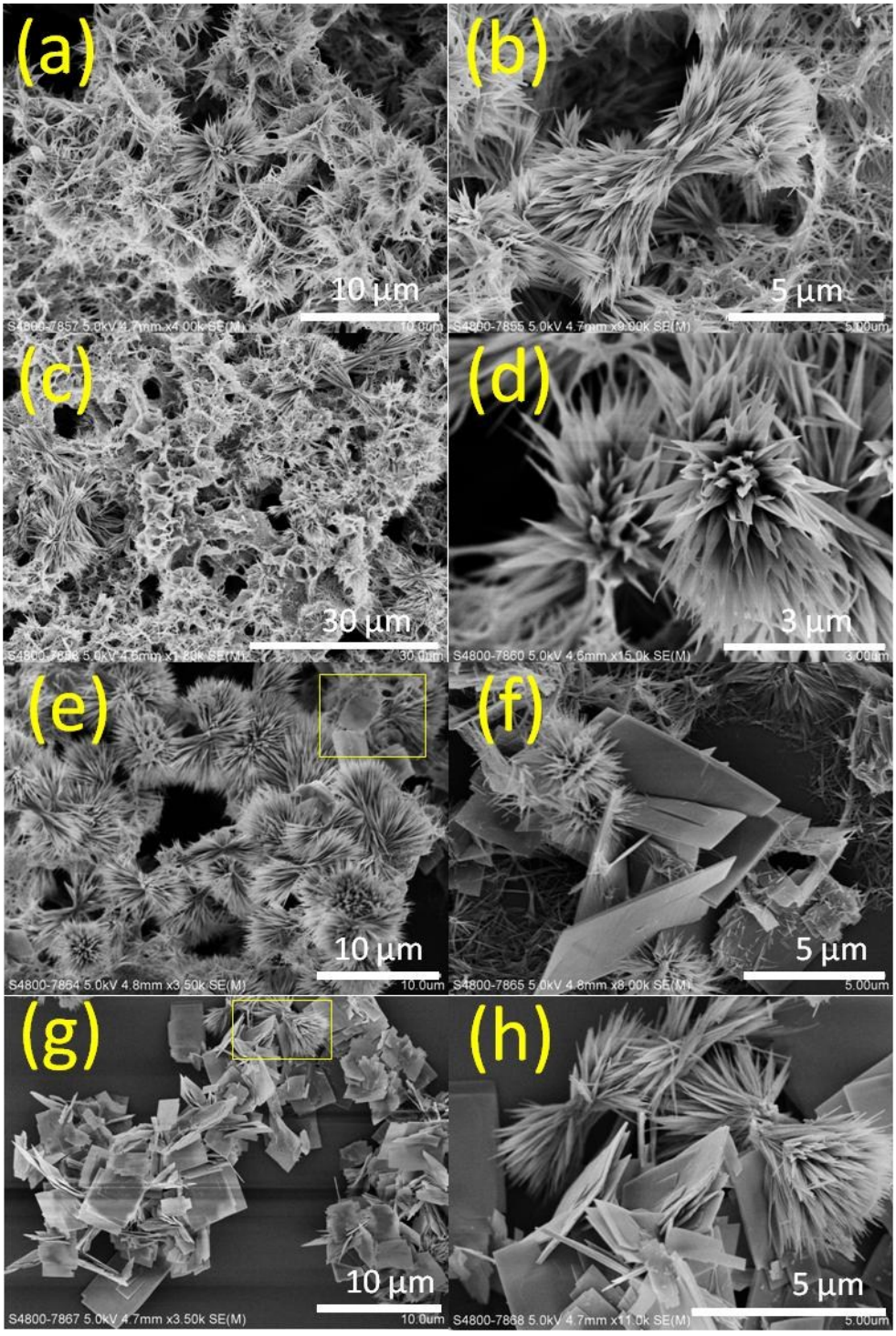

Fig. S11 Typical FE-SEM images of the as-prepared Co_3O_4 precursors (1.25 g $Co(ac)_2$, 3 g urea and 5 g PDDA) collected at different hydrothermal stages (a,b) 1 hour; (c,d) 2 hours; (e,f) 4 hours; (g,h) 8 hours

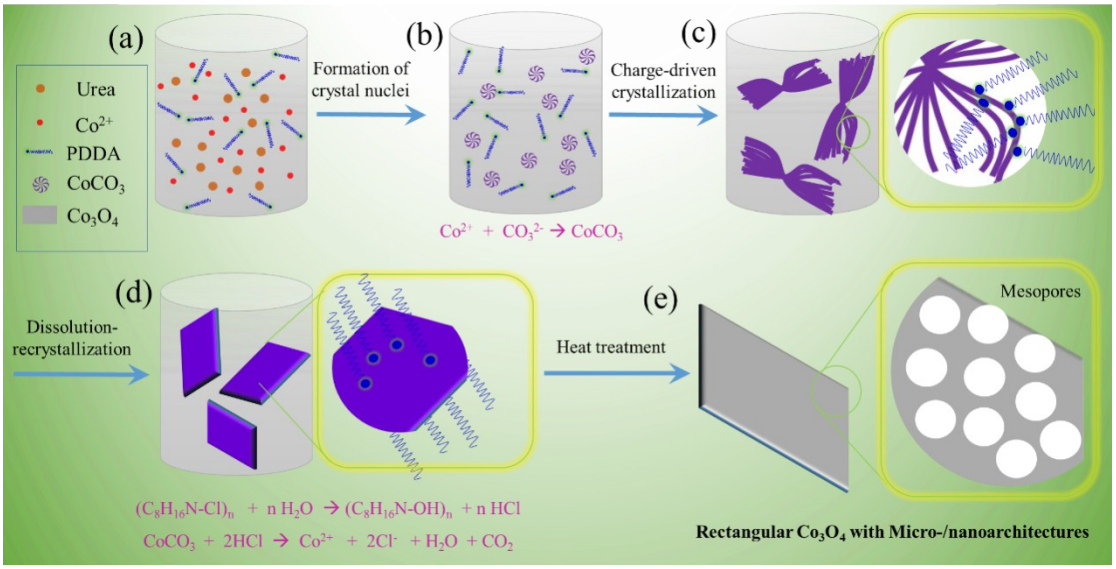

Fig.S12 Schematic illustration of the formation of rectangular Co_3O_4 with micro-/nanoarchitectures by charge-drive crystallization-dissolution-recrystallization mechanism. Note: The dissolution of $CoCO_3$ precursors is due to the presence of HCl released from hydrolysis of PDDA

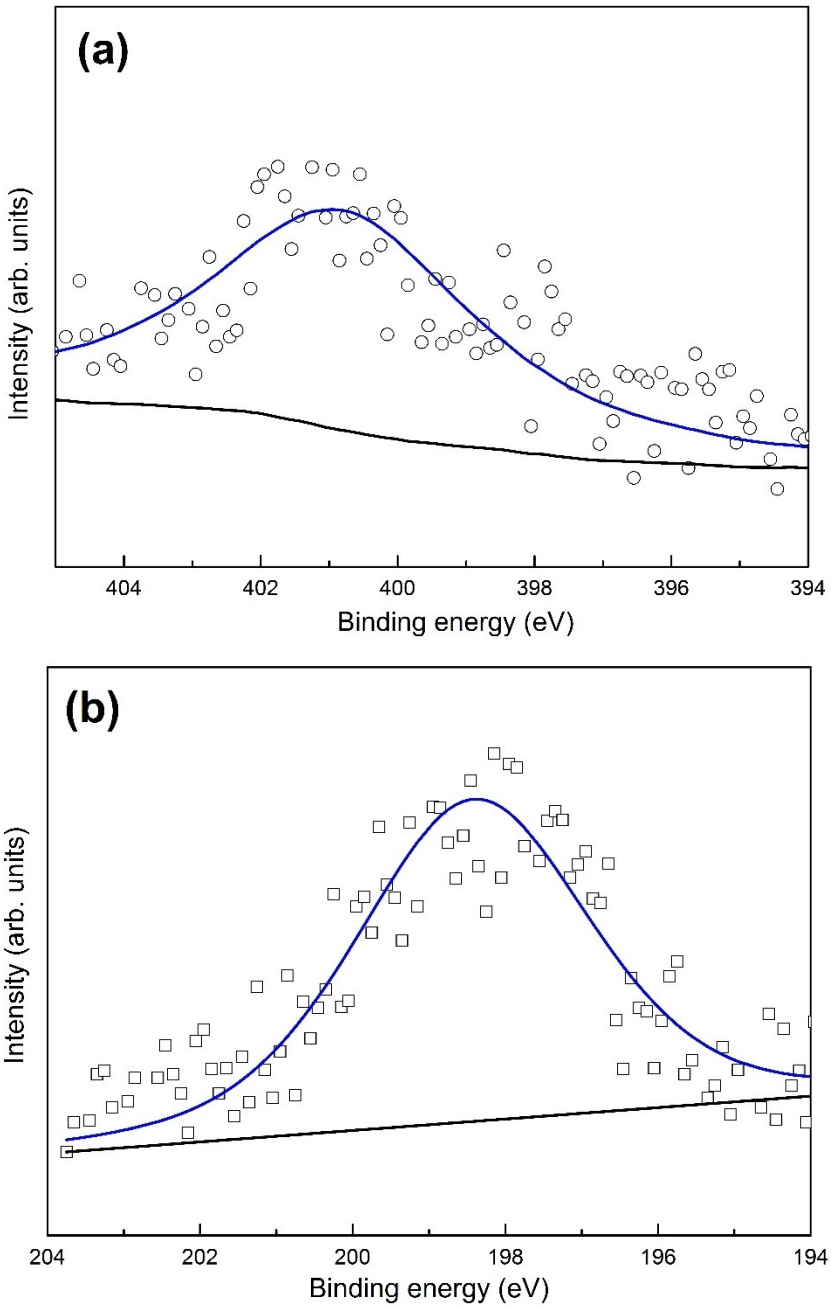

Fig.S13 XPS high resolution spectra of the as-prepared Co_3O_4 precursors (a) N 1s; (b) Cl 2p.

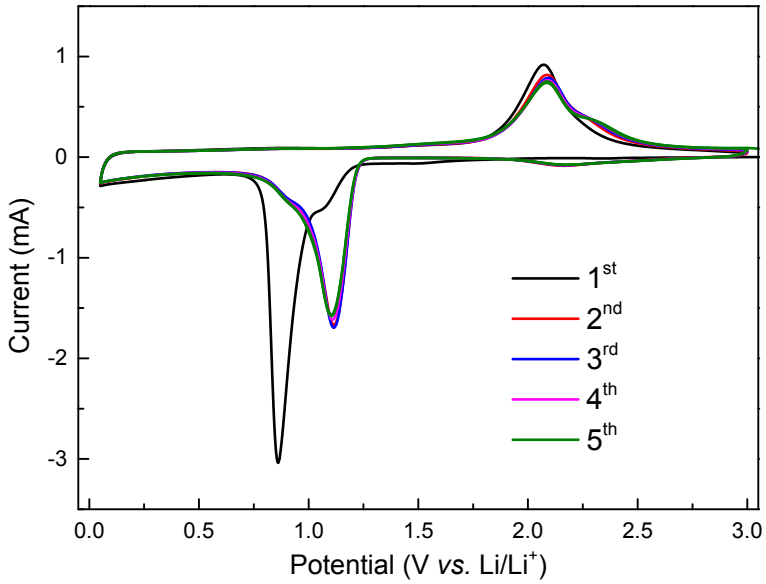

Fig. S14 Typical cyclic voltammetry curves for the first 5 cycles of Co_3O_4 sample (FST-1) tested with a scan rate of 0.1 $mV \cdot sec^{-1}$ at room temperature

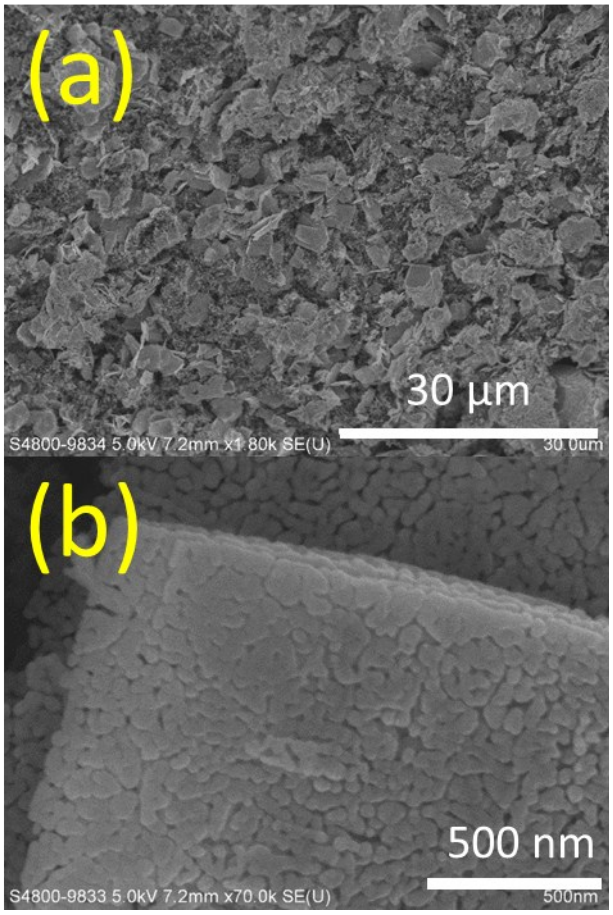

Fig.S15 FE-SEM images of FST-1 Co_3O_4 electrode after evaluation at a current density of 500 mA g^{-1} for 100 cycles

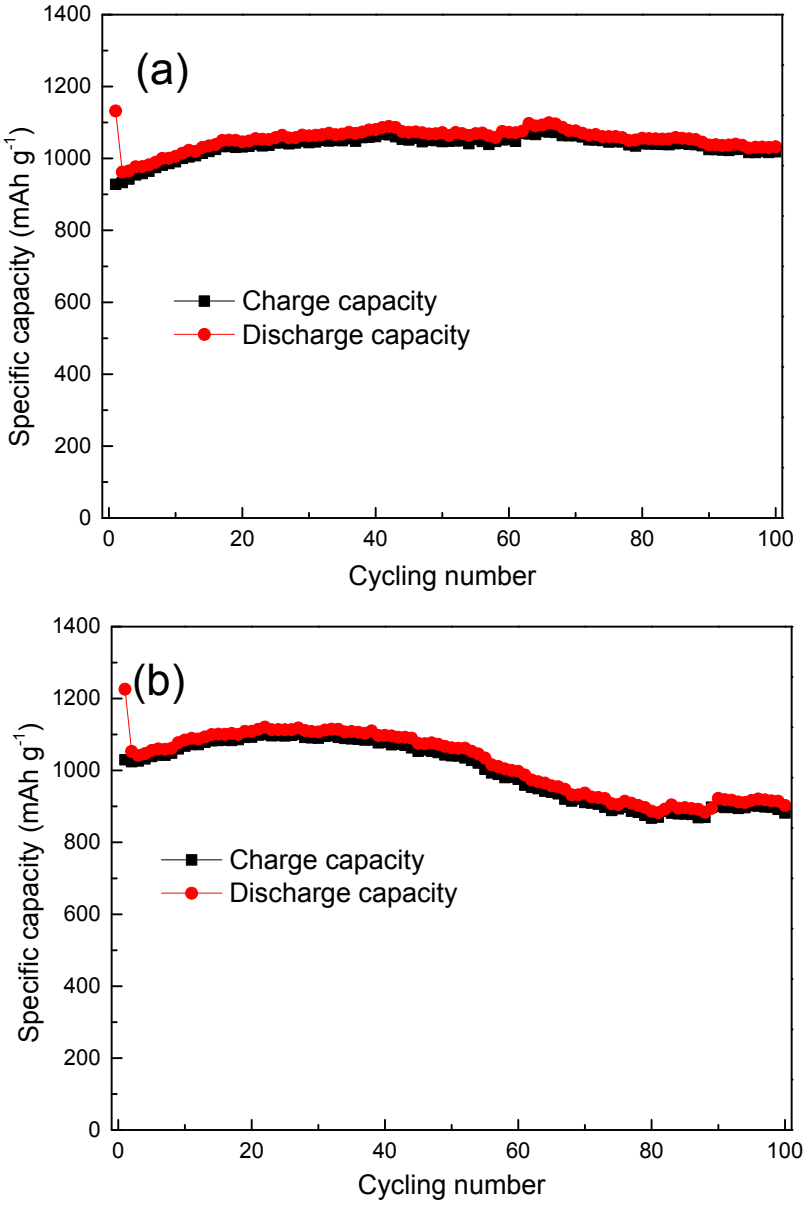

Fig. S16 Battery cycling performances of reference Co_3O_4 electrodes tested at a current density of 500 mA $g^{-1}$for 100 cycles (a) Co_3O_4 electrode materials synthesized with 2.5 g PDDA (MW: 200-350K); (b) Co_3O_4 electrode materials synthesized with 5.0 g PDDA (higher MW: 400-500K)

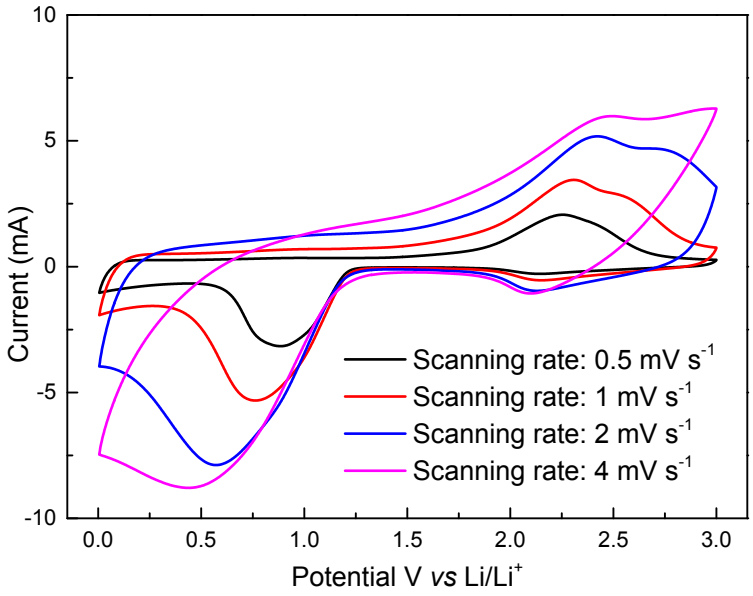

Fig. S17 Typical CV curves of Co_3O_4 electrode (FST-2) tested at scanning rates ranging from 0.5 to 4 mV S^{-1}

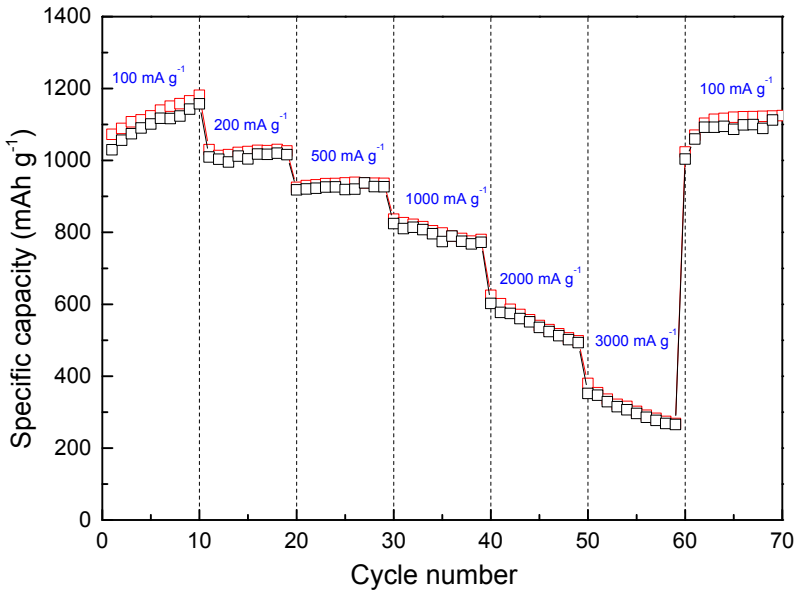

Fig. S18 Rate capability performance of FST-2 tested at different current densities ranging from 100 mA g^{-1} to 3000 mA g^{-1}

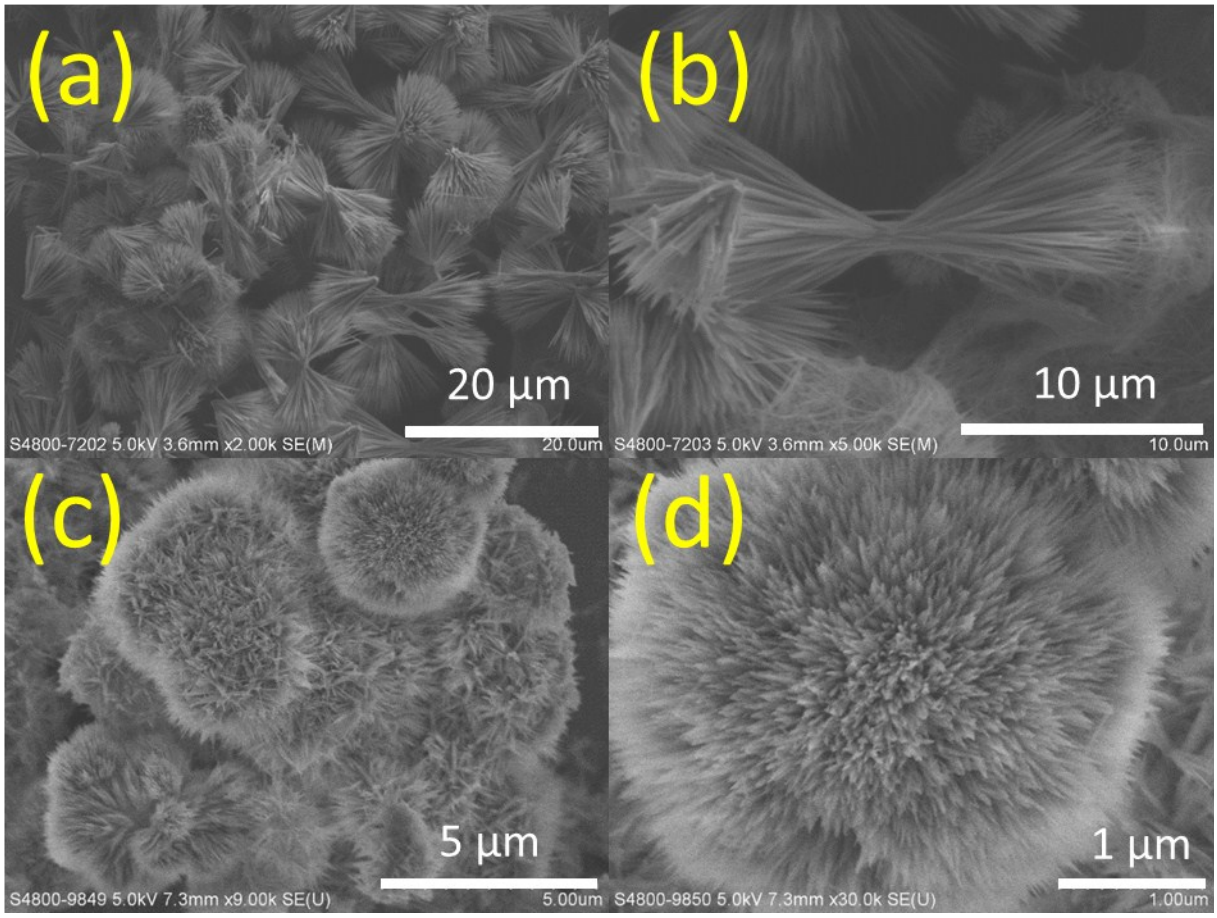

Fig. S19 Typical FE-SEM images of metal oxide precursors synthesized by polyelectrolyte-assisted hydrothermal method (a, b) PDDA-assisted synthesis of Co_3O_4 precursors with a hydrothermal duration of 2 hours and reduced concentration; (c, d) PBBU-assisted synthesis of $NiCo_2O_4$ precursors with a hydrothermal duration of 12 hours.