Electronic Supplementary Information (ESI)

Hierarchical Porous Hollow $FeFe(CN)_6$ Nanospheres Wrapped by I-Doped Graphene as Anode Materials for Lithium-ion Batteries

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EXPERIMENTAL DETAILS

Synthesis of the $FeFe(CN)_6$ nanocubes: PVP (3.00 g) and $K_3[Fe(CN)_6]$ (138.2 mg) were added to a 0.05 M HCl solution (52.5 mL) under magnetic stirring. After 60 min of stirring, the pale yellow solution was obtained. Then, the pale yellow solution was then placed into water bath and heated at 80 °C for 24 h under magnetic stirring. The precipitates were collected by centrifugation and washed several times in distilled water and ethanol. After drying at 60 ℃ for 12 h, $FeFe(CN)_6$ nanocubes were obtained. $FeFe(CN)_6$ spheres was prepared in the same way with 0.5-0.8 M HCl solution. When the concentration of hydrochloric acid is between 0.1-0.5 M, the morphology of $FeFe(CN)_6$ is between cubes and spheres.

Synthesis of the Prussian blue ($Fe_4[Fe(CN)_6]_3$): $Fe_4[Fe(CN)_6]_3$ was synthesized by a simple one-step co-precipitation method. Stoichiometric amounts of $FeCl_3$ (5 mmol) and $K_4Fe(CN)_6$ (3.75 mmol) were dissolved in 50 mL deionized water respectively. Then the $K_4Fe(CN)_6$ solution was slowly added to the $FeCl_3$ solution during continuous stirring. The resulting solution was stirred for another 2 h at 55 ℃ temperature. The dark blue solid product ($Fe_4[Fe(CN)_6]_3$) was collected by centrifugation, washed several times with de-ionized water and ethanol, and dried in vacuum at 60 ℃ for overnight.

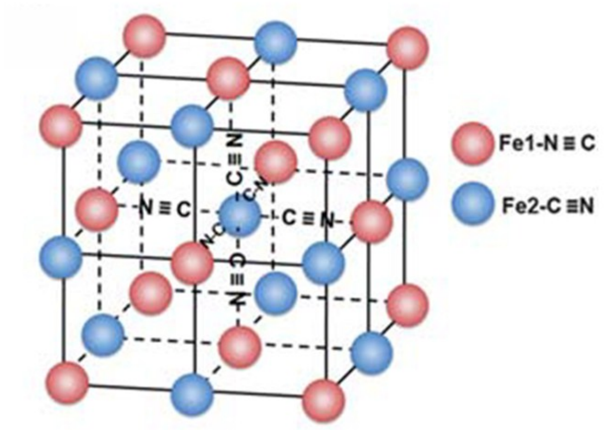

Fig. S1. Unit cell of $FeFe(CN)_6$.[1]

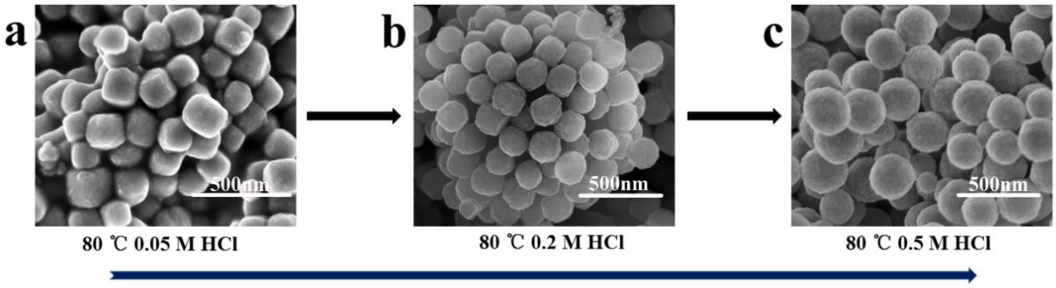

Fig. S2. SEM images of the $FeFe(CN)_6$ cubes (0.05 M HCl) (a), the mixture of $FeFe(CN)_6$ cubes and spheres (0.2 M HCl) (b), $FeFe(CN)_6$ spheres (0.5 M HCl) (c).

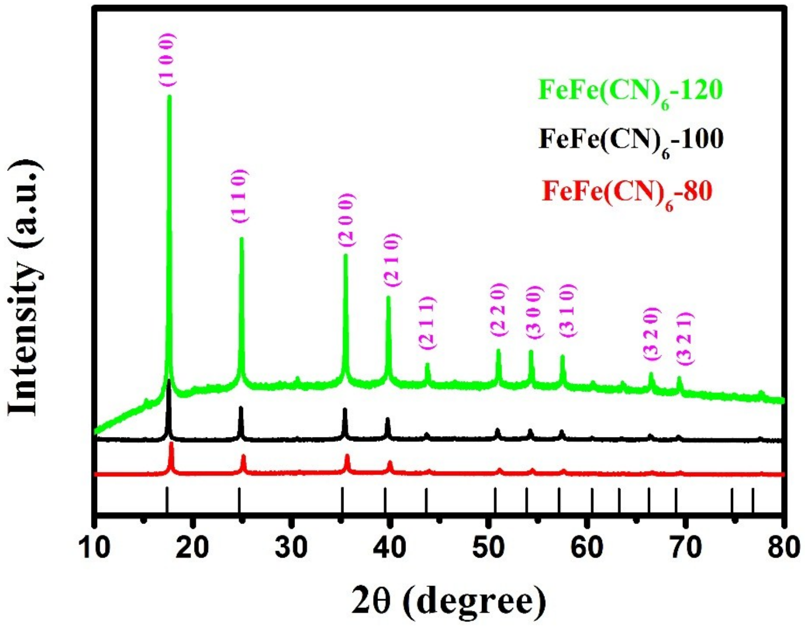

Fig. S3. XRD pattern of $FeFe(CN)_6$-80, $FeFe(CN)_6$-100 and $FeFe(CN)_6$-120.

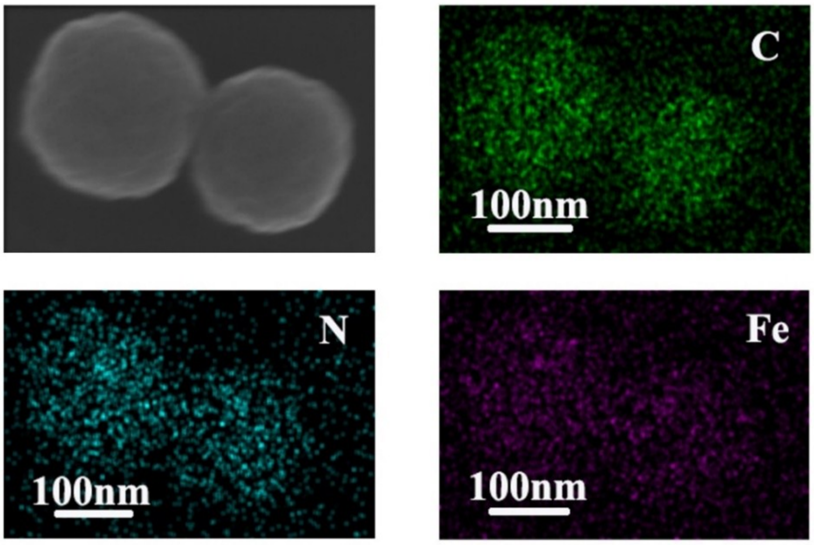

Fig. S4. Elemental mapping images of $FeFe(CN)_6$-100 nanospheres.

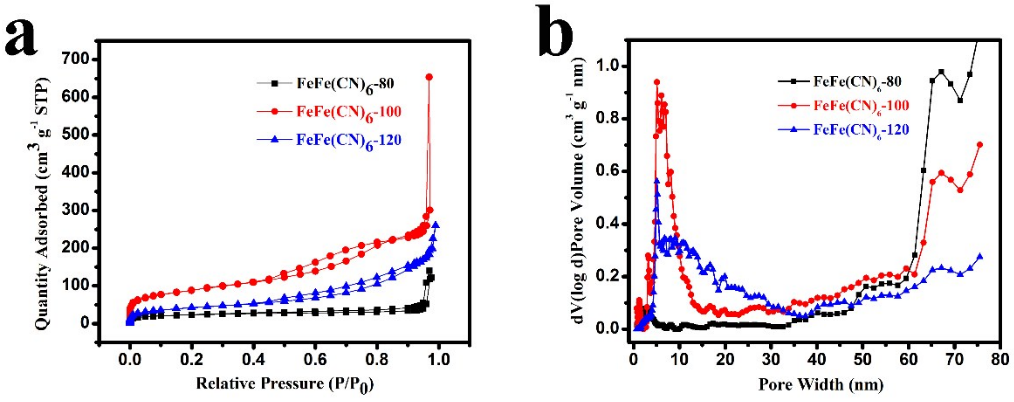

Fig. S5. (a) N_2 adsorption-desorption isotherm and (b) the corresponding pore size distribution of $FeFe(CN)_6$-80, $FeFe(CN)_6$-100 and $FeFe(CN)_6$-120, respectively.

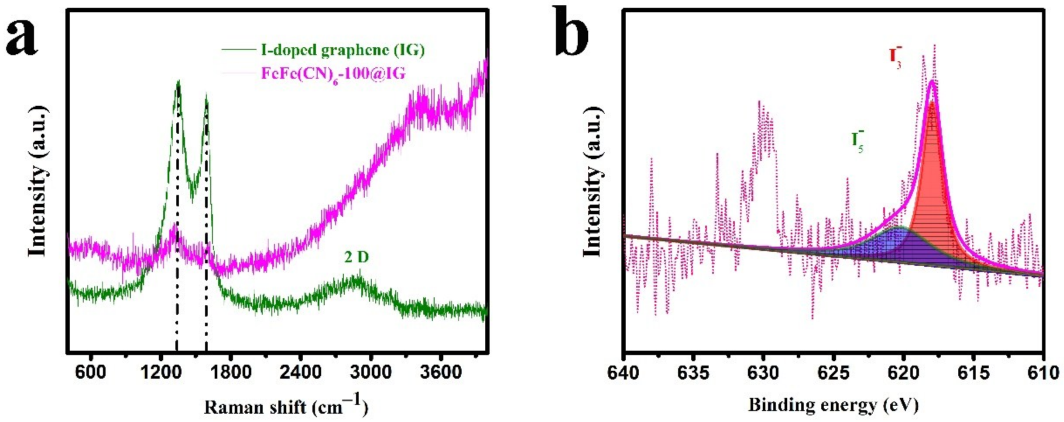

Fig. S6. (a) Raman spectra of the IG and FeFe(CN)$_6$-100@IG. (b) XPS spectra of the IG.

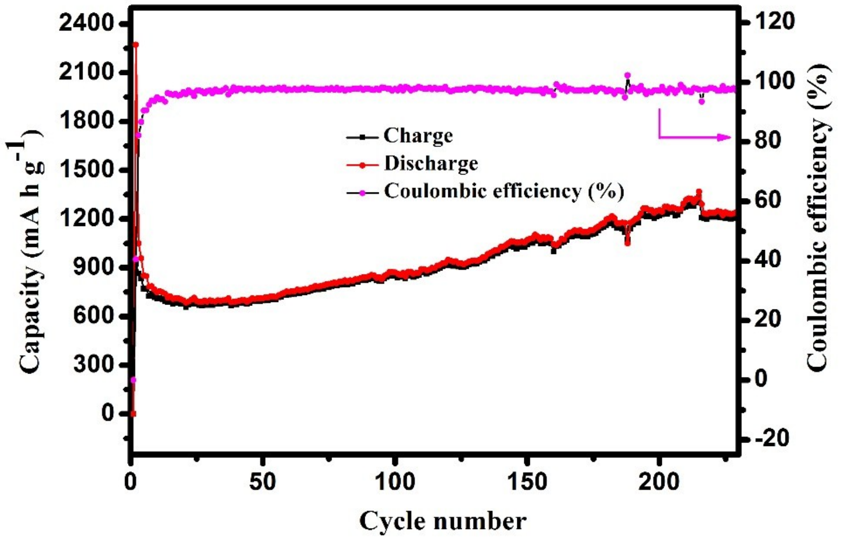

Fig. S7. Cycling performance of the I-doped graphene (IG) at a current density of 200 mA g^{-1}.

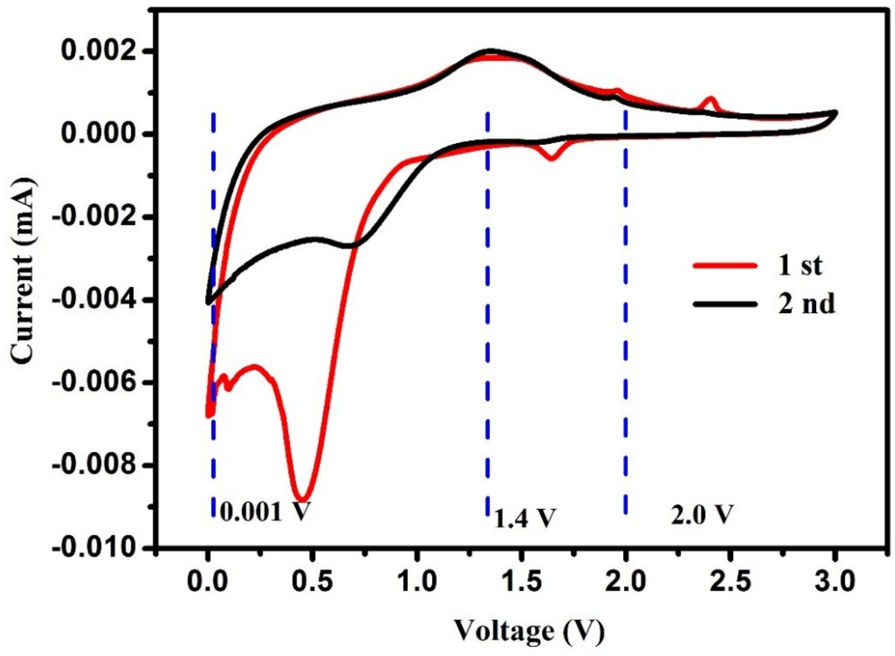

Fig. S8. CV curves of the FeFe(CN)$_6$-100@IG nanocomposites for initial tow cycles at 0.001 V s^{-1} scan rate.

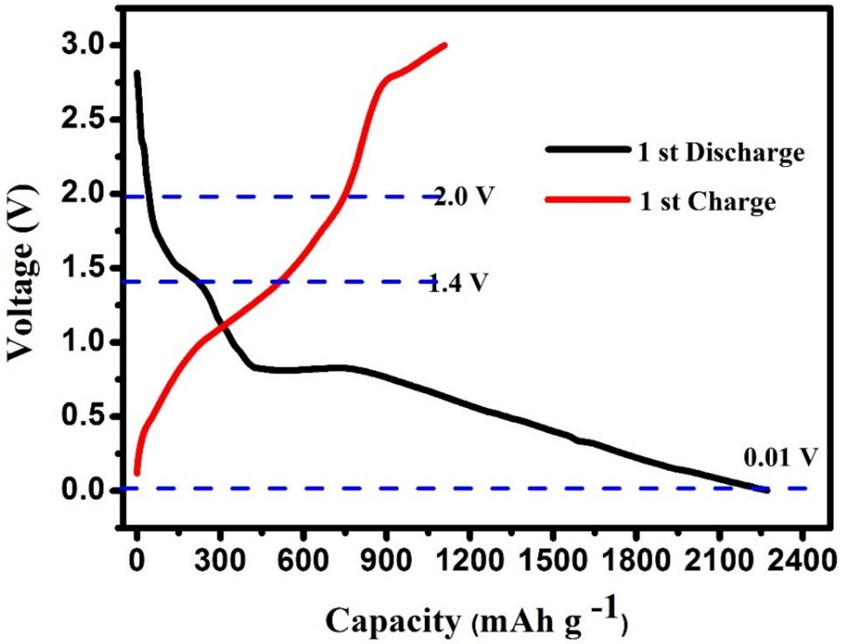

Fig. S9. the voltage profile of $FeFe(CN)_6$-100@IG in the initial cycle at a current density of 100 mA g^{-1}.

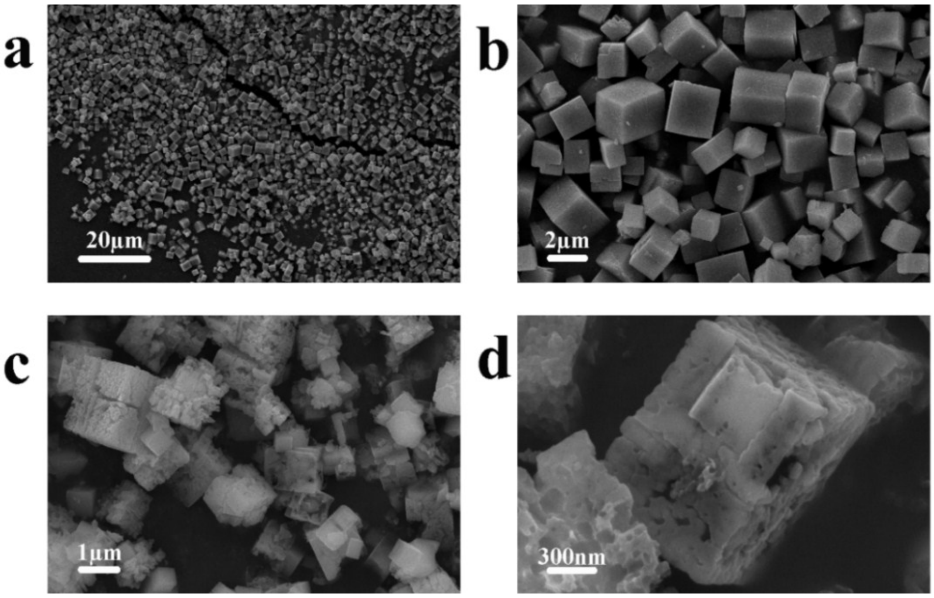

Fig. S10. (a, b) SEM images of the $Fe_4[Fe(CN)_6]_3$ at different magnifications. (c, d) SEM images of hollow mesoporous $Fe_4[Fe(CN)_6]_3$.

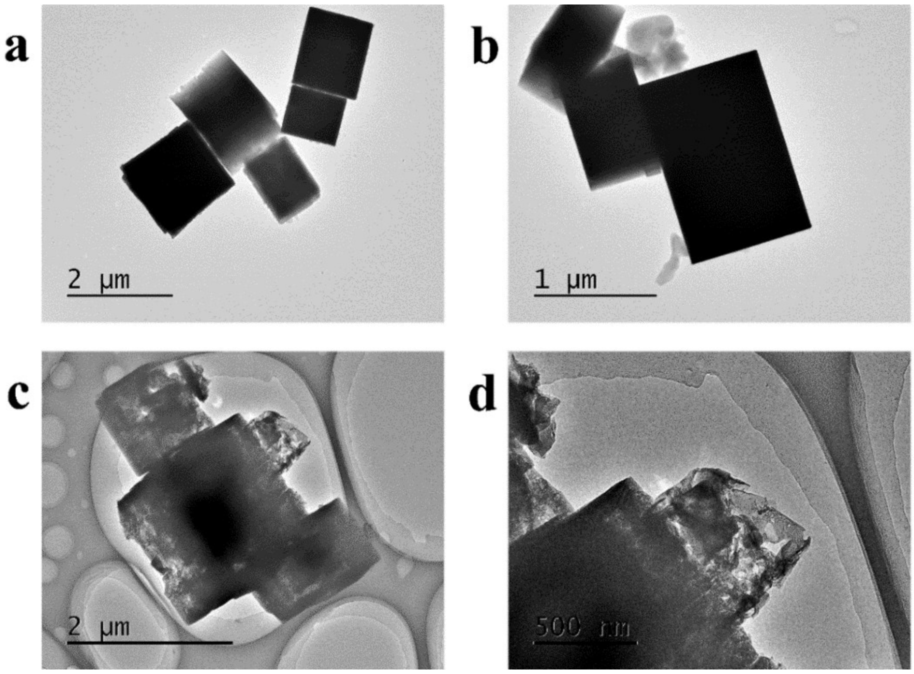

Fig. S11. (a, b) TEM images of the $Fe_4[Fe(CN)_6]_3$ at different magnifications. (c, d) SEM images of hollow mesoporous $Fe_4[Fe(CN)_6]_3$.

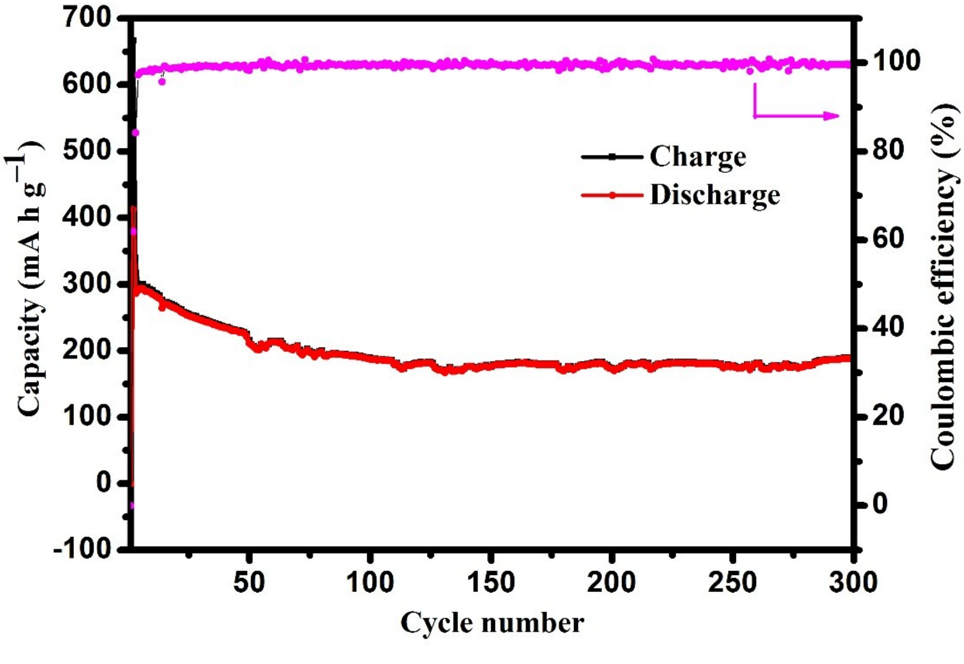

Fig. S12. Cycling performance of the $Fe_4[Fe(CN)_6]_3$@IG at a current density of 2000 mA g^{-1}.

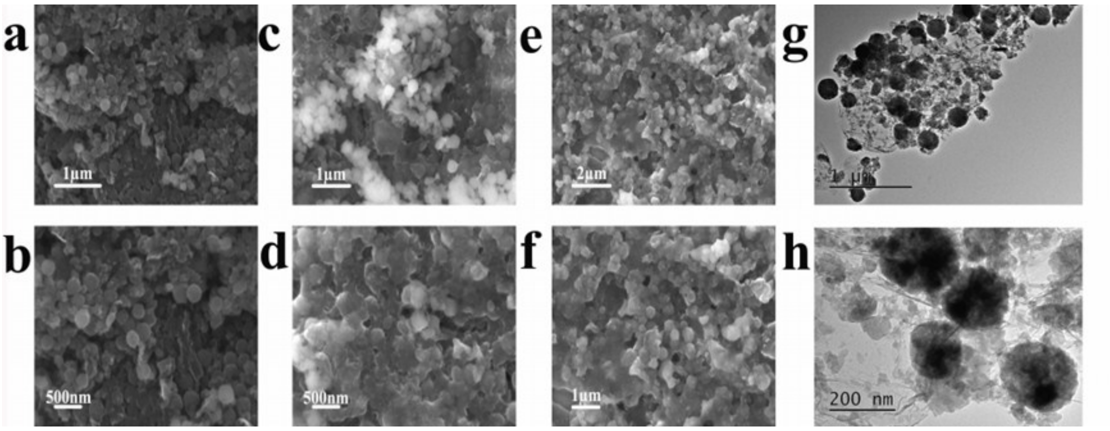

Fig. S13. (a, b) SEM images of fresh electrode $FeFe(CN)_6$-100@IG. SEM images of electrode after 100 cycles at a current density of 100 mA g^{-1} (c, d) and 1000 mA g^{-1} (e, f). (g, h) TEM images of the electrode after 10 cycles at a current density of 100 mA g^{-1}.

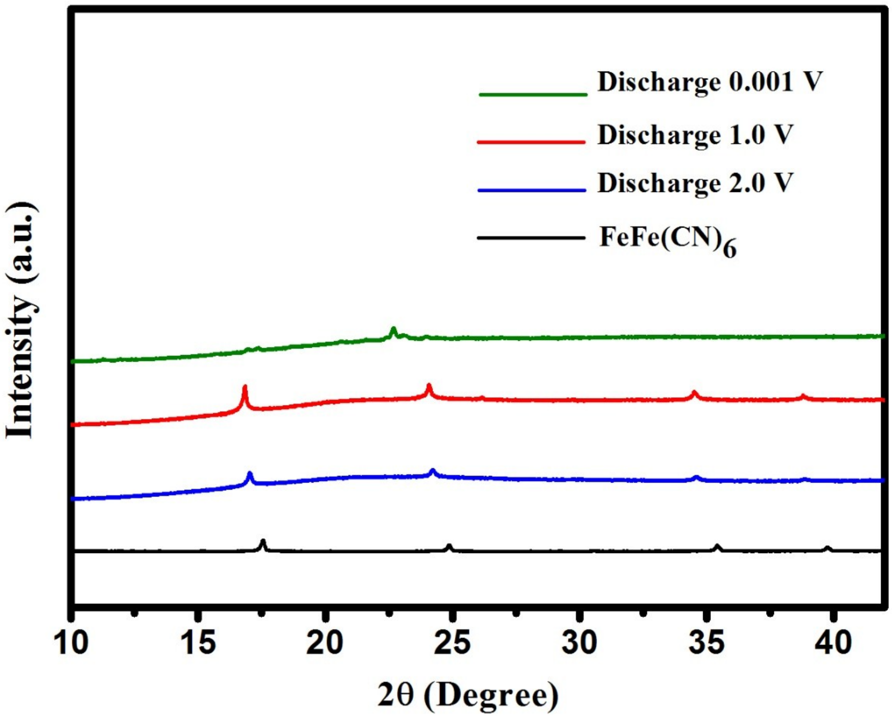

Fig. S14. XRD patterns of $FeFe(CN)_6$-100 electrodes collected from the batteries after their 1st discharge processes.

References

1 X. Wu, W. Deng, J. Qian, Y. Cao, X. Ai, and H. Yang, J. Mater. Chem. A, 2013, 1, 10130-10134.