香港中文大學
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Construction of ultra-high energy and power density Li ion capacitor with Fe_3O_4/C anode and activated carbon cathode

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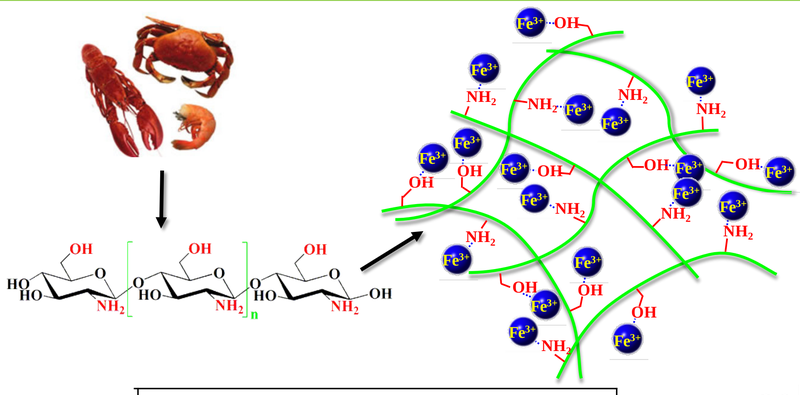
Research Background

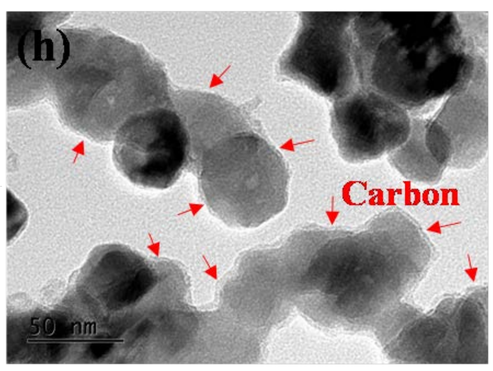
Lithium ion capacitors (LICs) has been regarded as a promising avenue to bridge the gap between high-energy lithium ion batteries and high-power supercapacitors. It stores charge by nonfaradaic surface adsorption / desorption of electrolyte anions over the capacitor-type cathode and faradic lithium ion intercalation / deintercalation reaction with the battery-type anode. Since two charge-storage mechanisms coexist in one system, the key challenge to develop high performance LIC is to achieve the synergy between the sluggish faradic reaction kinetics of the anode and the fast nonfaradic charging rate of the cathode.

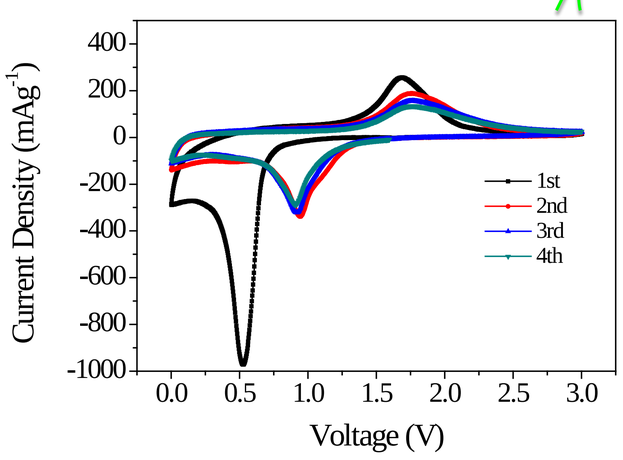
One effective strategy to mitigate this is discrepancy is to develop novel anode materials with simultaneously large specific capacities, superior rate capabilities, and ultra-stable cycling performances.

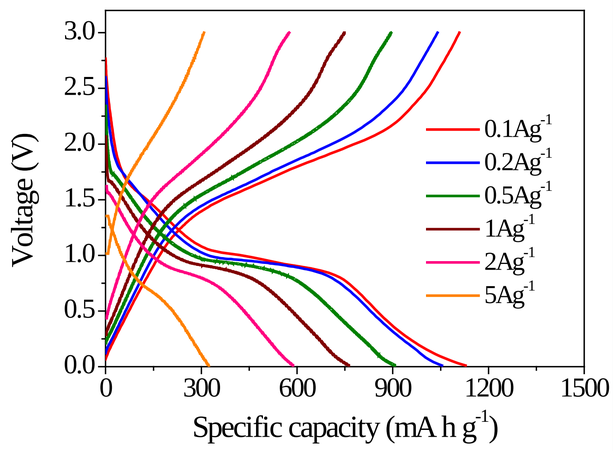
Results and Discussion

1.Biomass-assisted synthesis of Fe_3O_4 nanoparticle anode



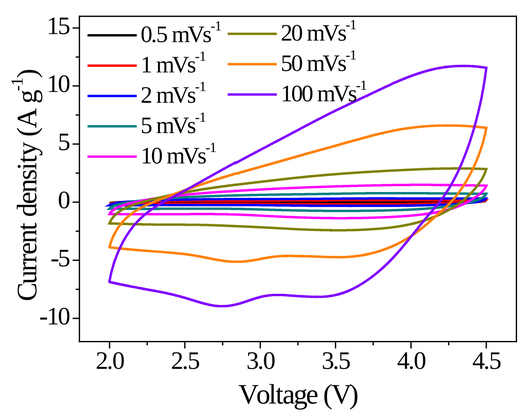


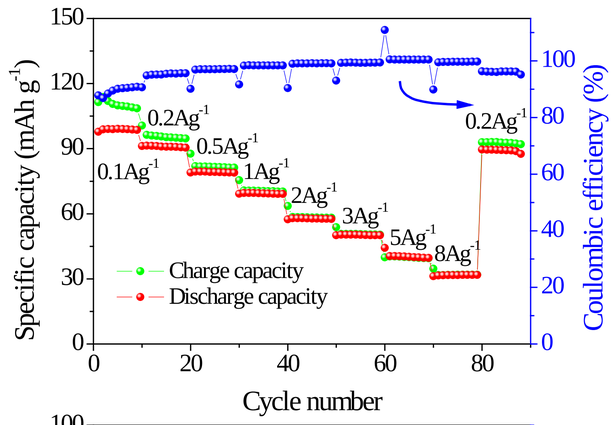


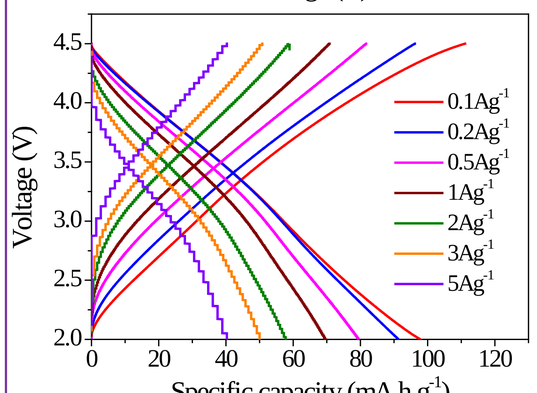


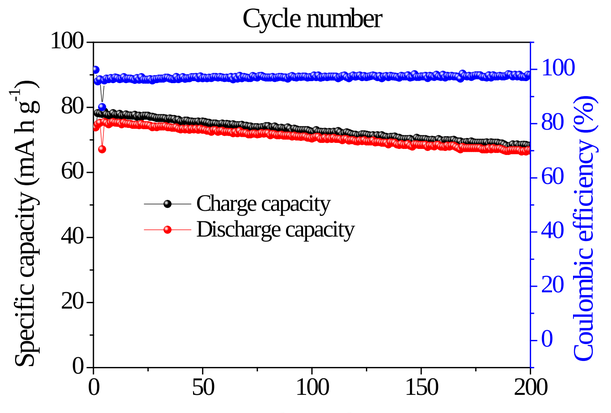
Fe_3O_4 with excellent battery performance was prepared by utilizing the correlation of metal ion with amino and hydroxyal groups of biomass material (chitosan)

2. Capacitor-type cathode: activated carbon



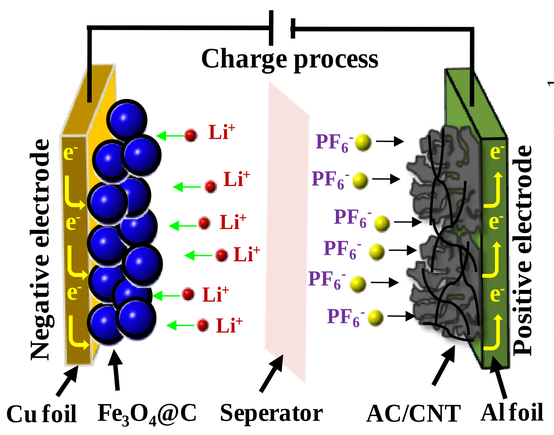


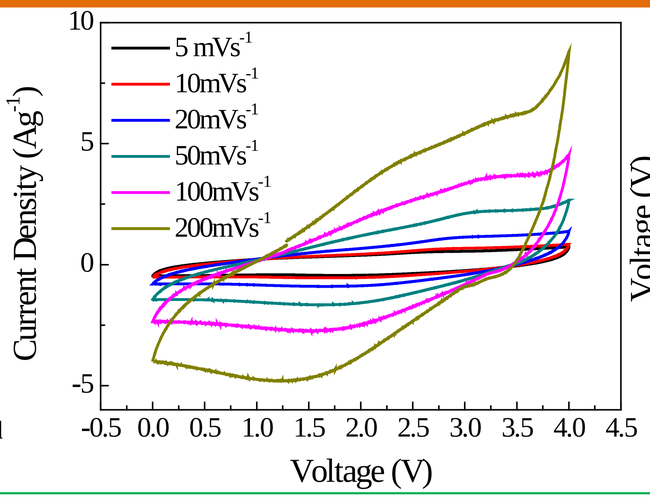


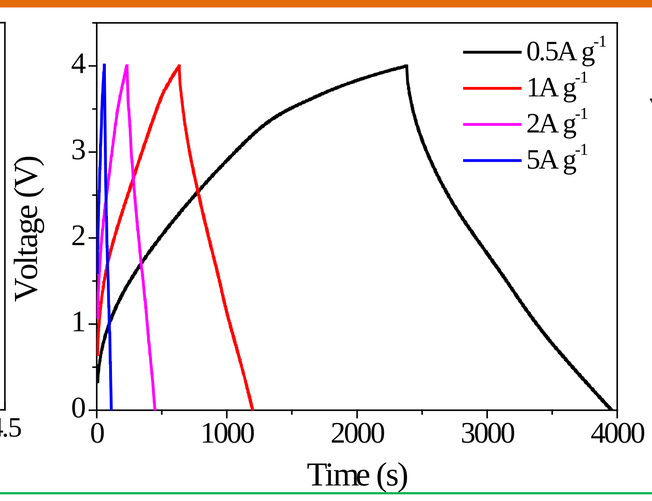


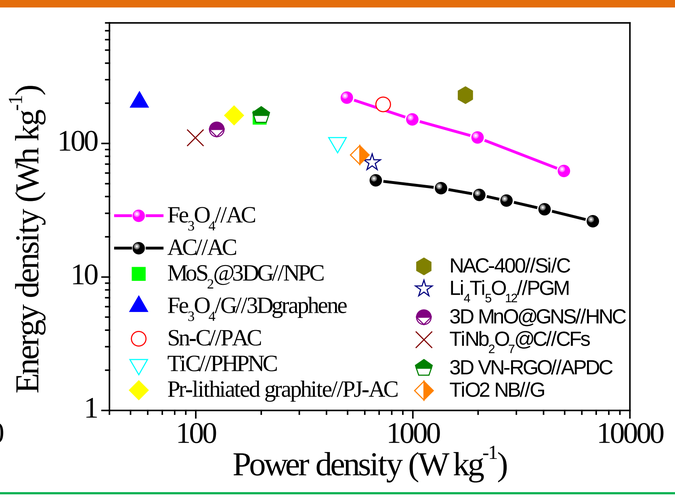
The incorporation of carbon nanotube (CNT) give rise to much enhanced capacitance of activated carbon

3.Construction of high performance Li ion capacitor with Fe_3O_4/C anode and activated carbon cathode









Conclusions

- Fe_3O_4 nanoparticles with *in-situ* formed surface carbon coating layer are prepared by utilizing the correlation of Fe^{3+} with chitosan biomass to achieve high specific capacity of anode.
- The assembled LIC (Fe_3O_4@C//AC) device delivers a high energy densities of 220 Wh kg^{-1} at the power densities of 497 W kg^{-1} with excellent cycling performance.