Double carbon structure energy storage device

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CONTENTS

Energy and environmental

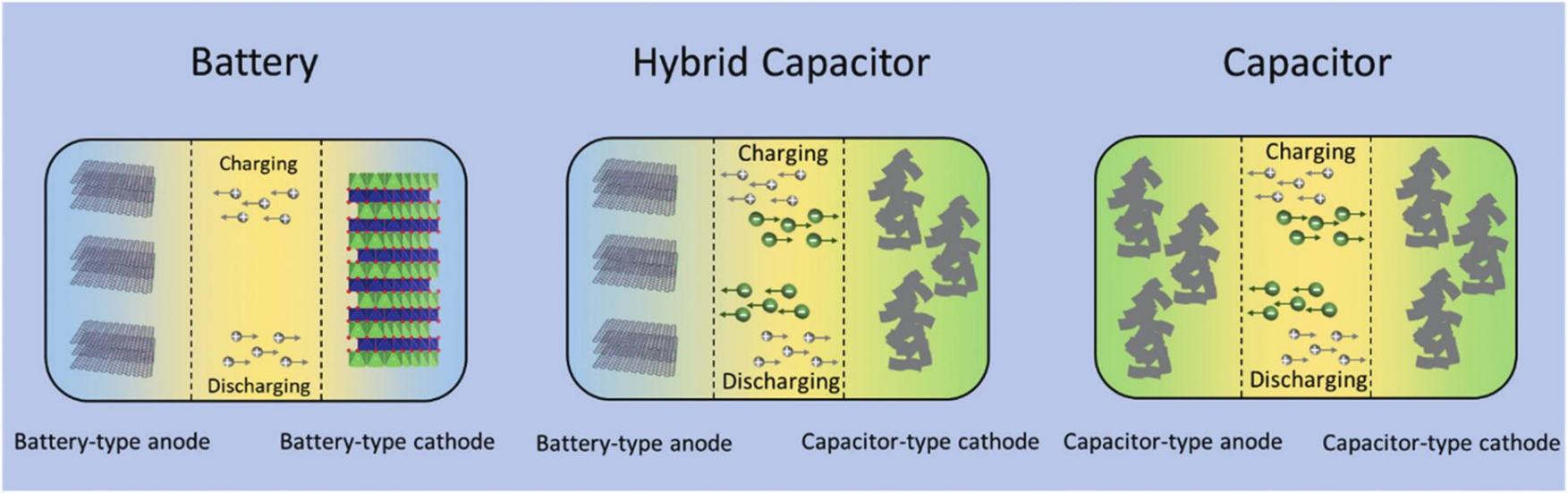
Introduction

Two major challenges facing human sustainable development in the 21st century - **energy** and **environmental** issues

Energy storage device

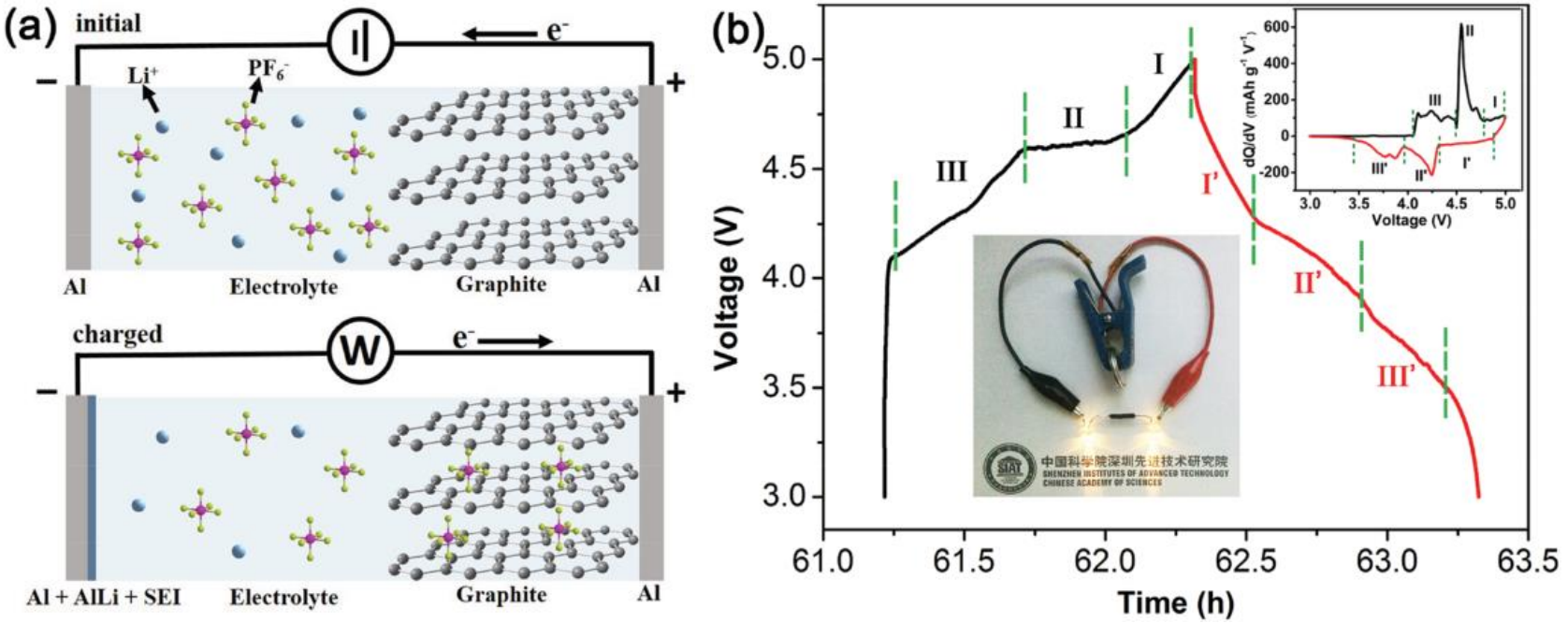
Electrochemical Energy storage device

- Battery
  - Rocking chair cell
  - Dual-ion cell
- Electrochemical capacitor
  - Hybrid capacitor
  - capacitor



Placke T, et al. ***Joule***, 2018, 2(12): 2528-2550.

Dual-ion batteries (DIBs)



Anode: $\mathrm{Al} + \mathrm{Li}^+ + \mathrm{e}^- \leftrightarrow \mathrm{AlLi}$

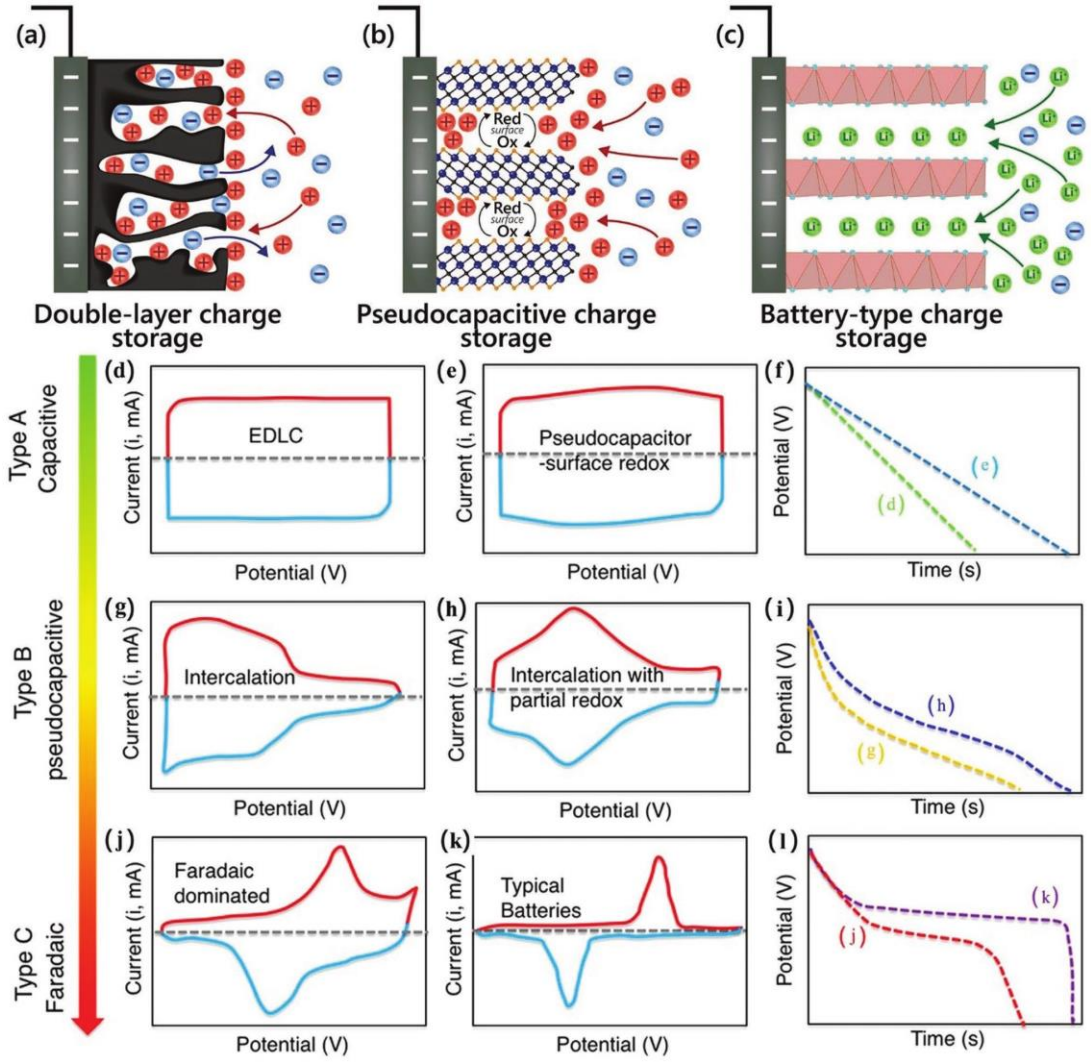
Cathode: $x\mathrm{C} + \mathrm{PF}_6^- \leftrightarrow \mathrm{C}_x(\mathrm{PF}_6) + \mathrm{e}^-$

Electrolyte: 4M LiPF_6 in EMC + 2 wt.% VC

Schematic illustration of the DIB in the initial state (up) and the charged state (below). b) Galvanostatic charge–discharge curve of the AGDIB at 0.5 C (1 C corresponding to a current rate of 100 mA g−1). Insets are the dQ/dV differential curve of the battery and a photograph showing that a single AGDIB cell lighting up two yellow LEDs in series.

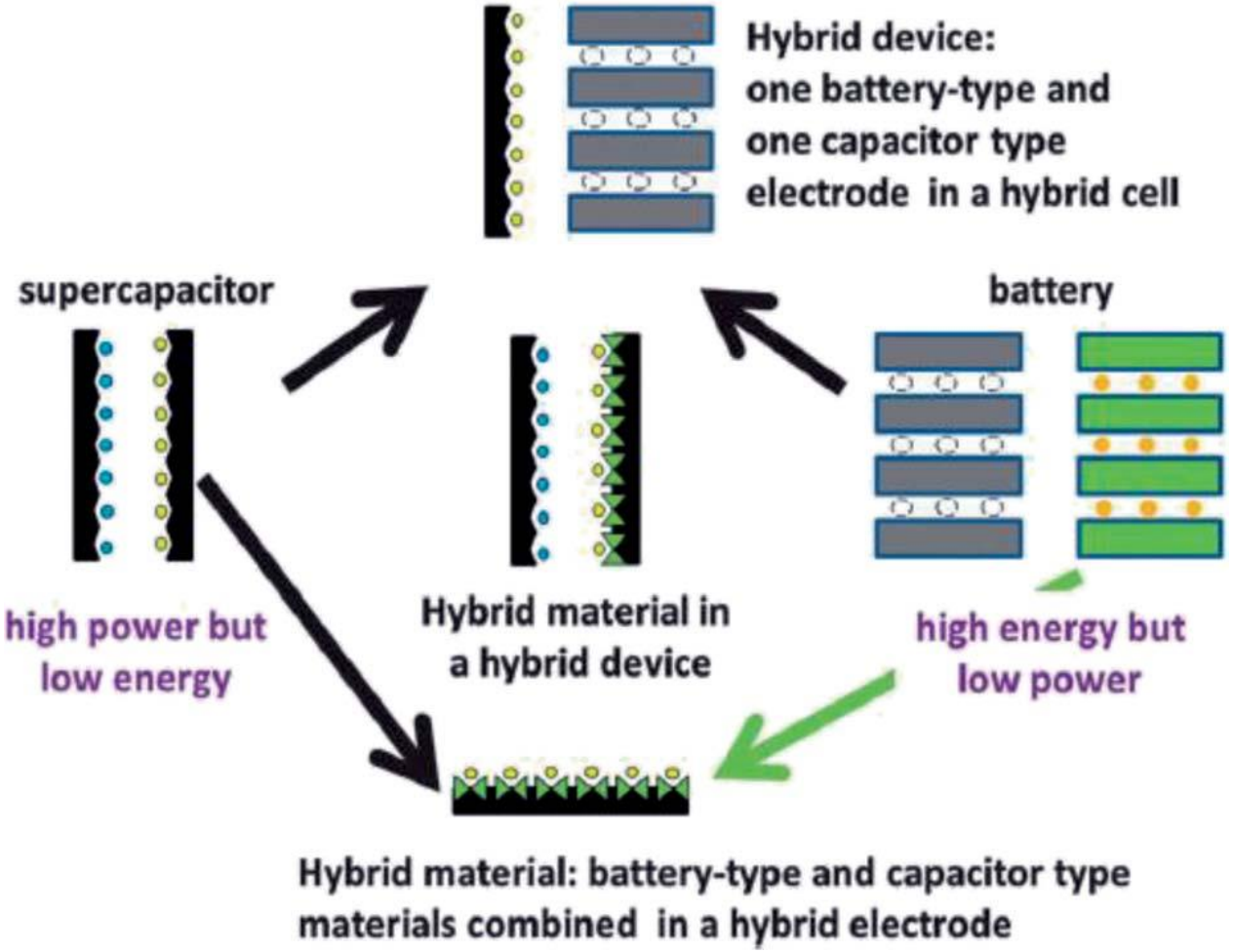
Xiaolong, Z et al. ***Adv. Energy Mater.*** 2016, 6, 1502588

Supercapacitor



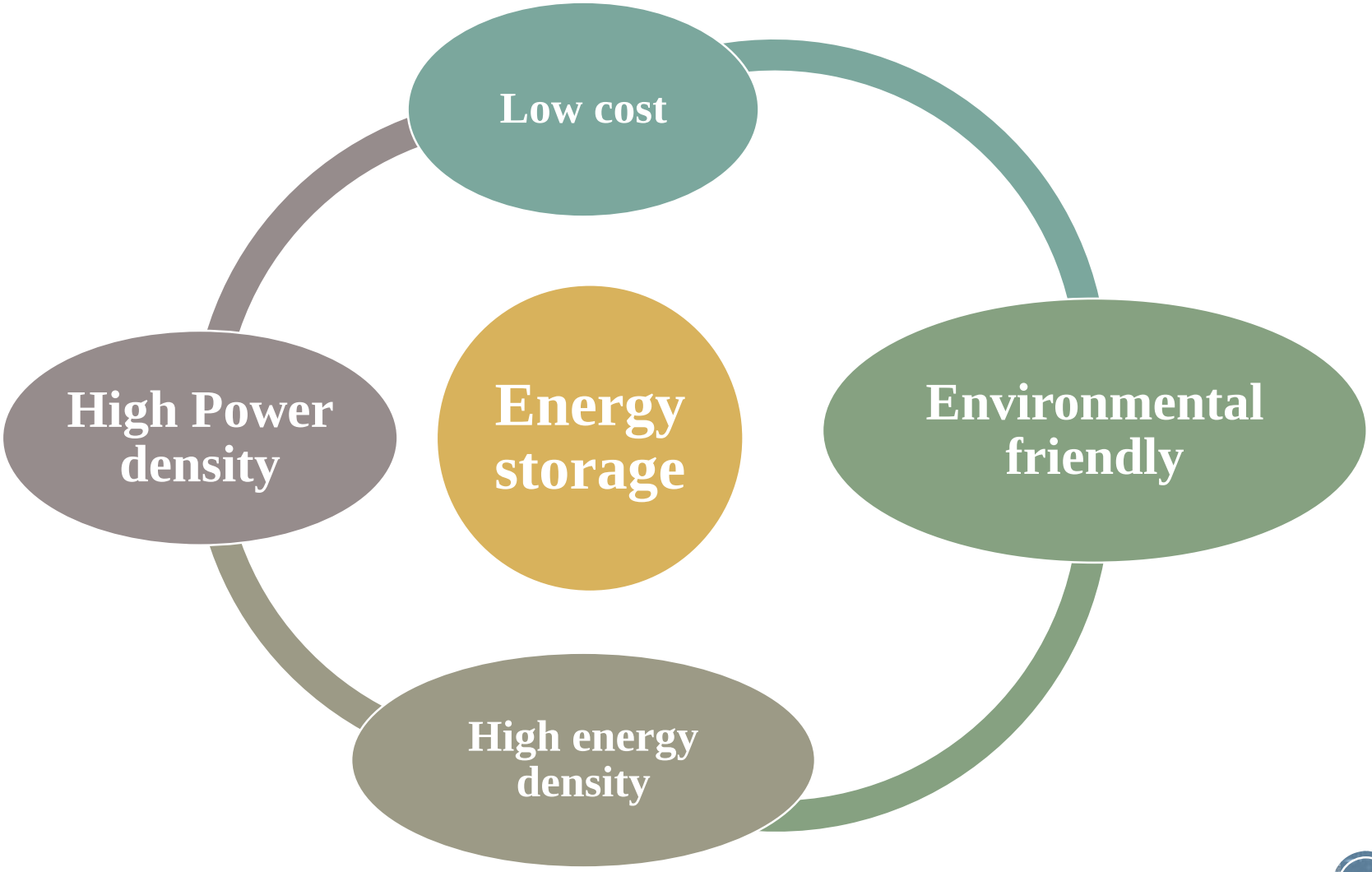
Haolin L. et al. **ACS Sustainable Chem. Eng**. *2019, 7, 12188−12199*

Hybrid supercapacity

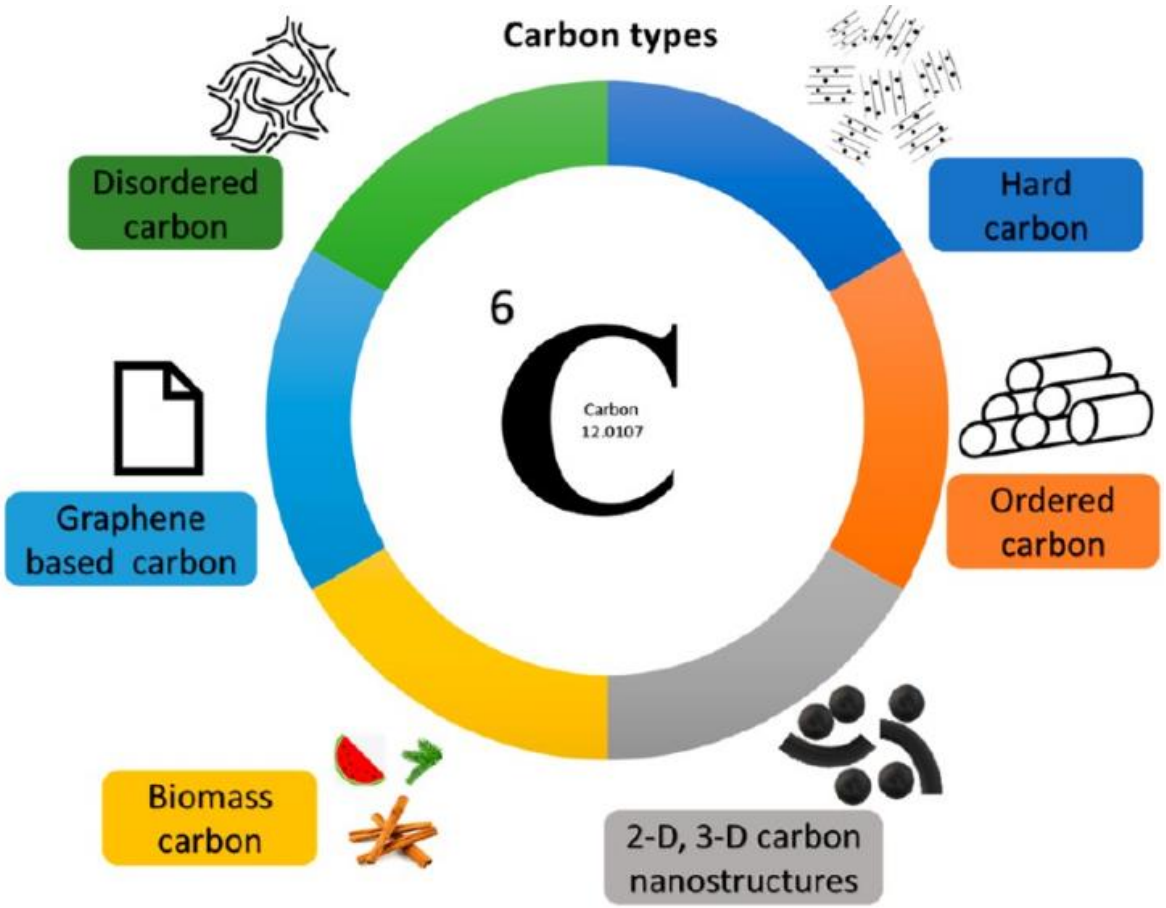


D. P. Dubal, O. Ayyad, V. Ruiz and P. Gomez-Romero, ***Chem. Soc. Rev.,*** 2015, 44, 1777–1790.

Motivation


Low cost
Environmental friendly
High energy density
High Power density
Energy storage

Carbon materials



Advantage:

- Low cost
- Abundant
- Environmentally friendly
- Conductivity
- Stability

Thangavel, R.et al. ***ACS Appl. Energy Mater.*** *2021, 4, 13376−13394*

Motivation

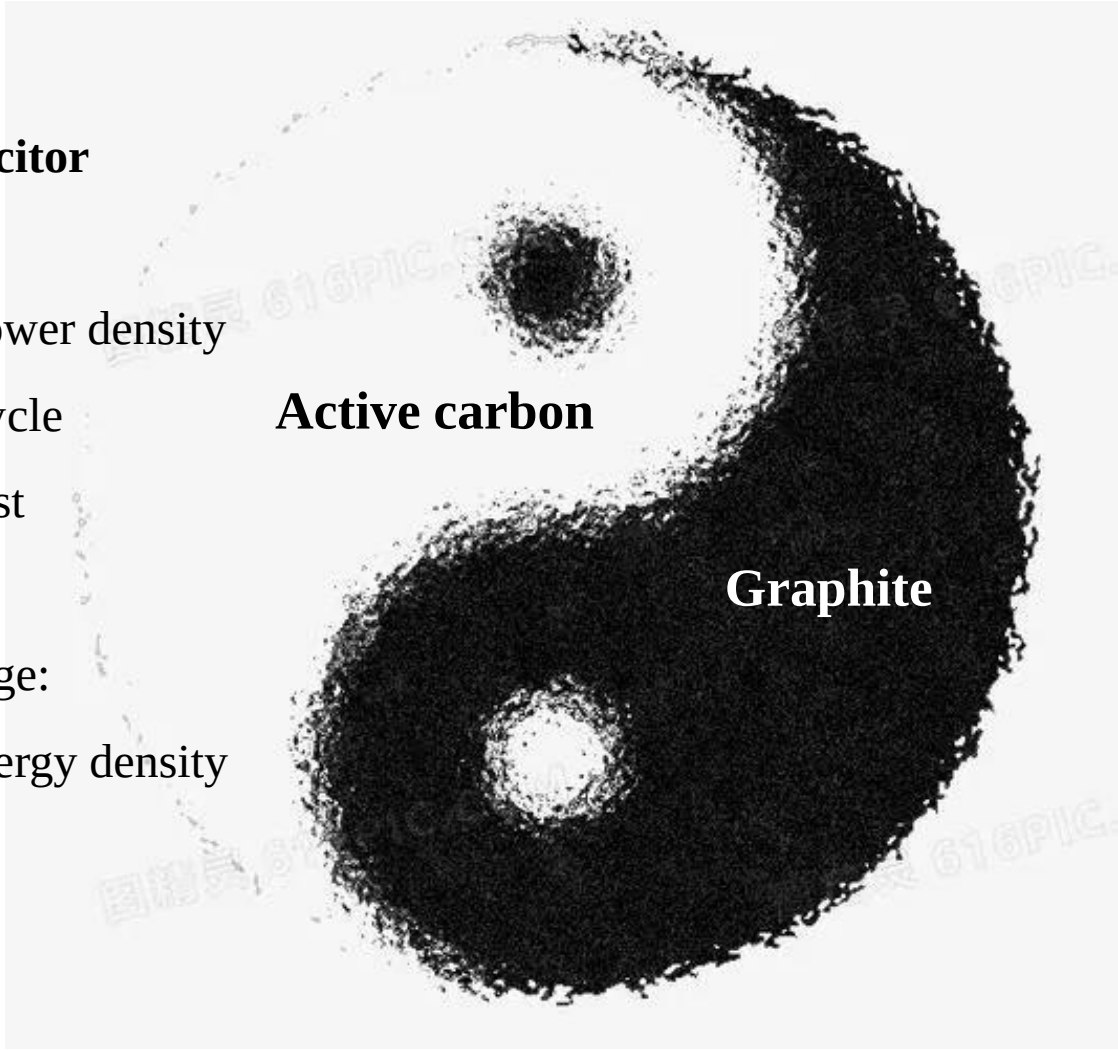
Supercapacitor

Advantage:

1. High power density
2. Long cycle
3. Low cost

Disadvantage:

1. Low energy density



Dual-ion batteries

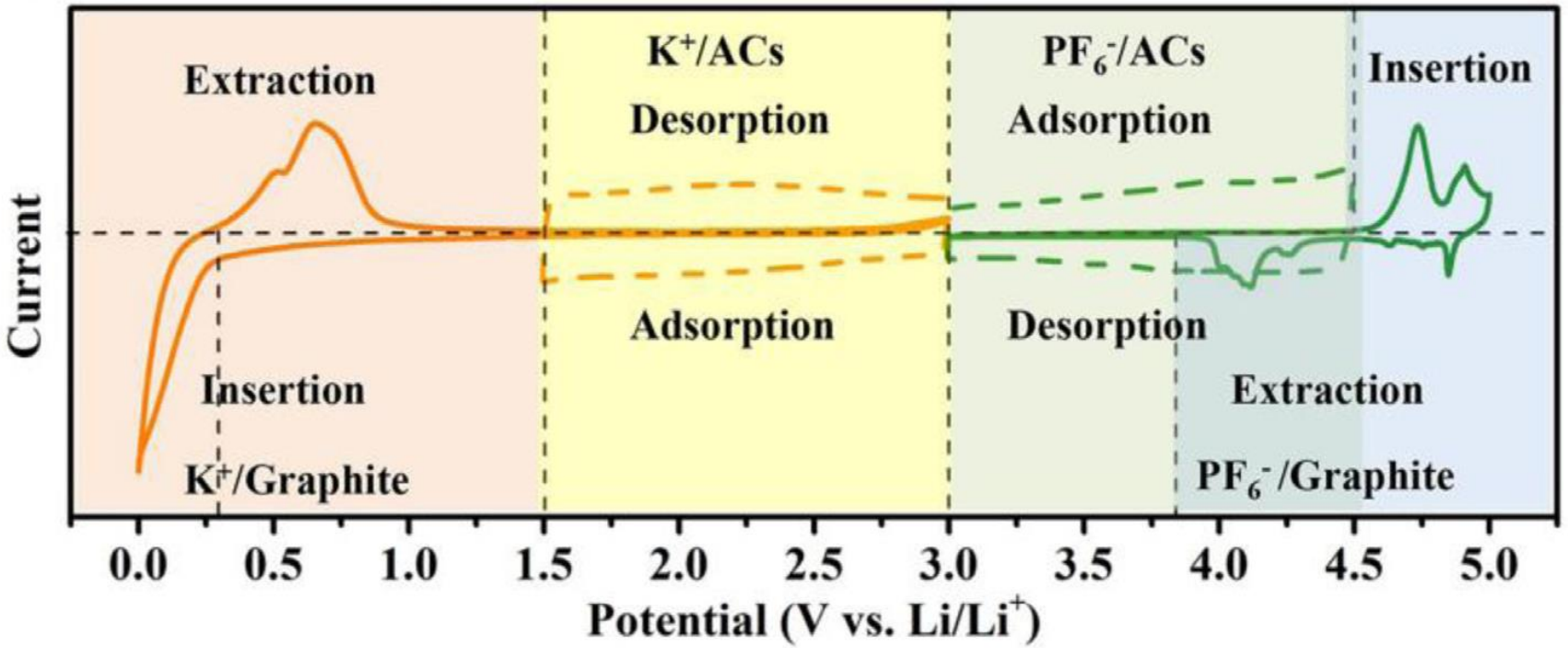
Advantage

1. High energy density
2. High voltage window
3. Low cost

Disadvantage:

1. Low power density
2. Low cycle-number

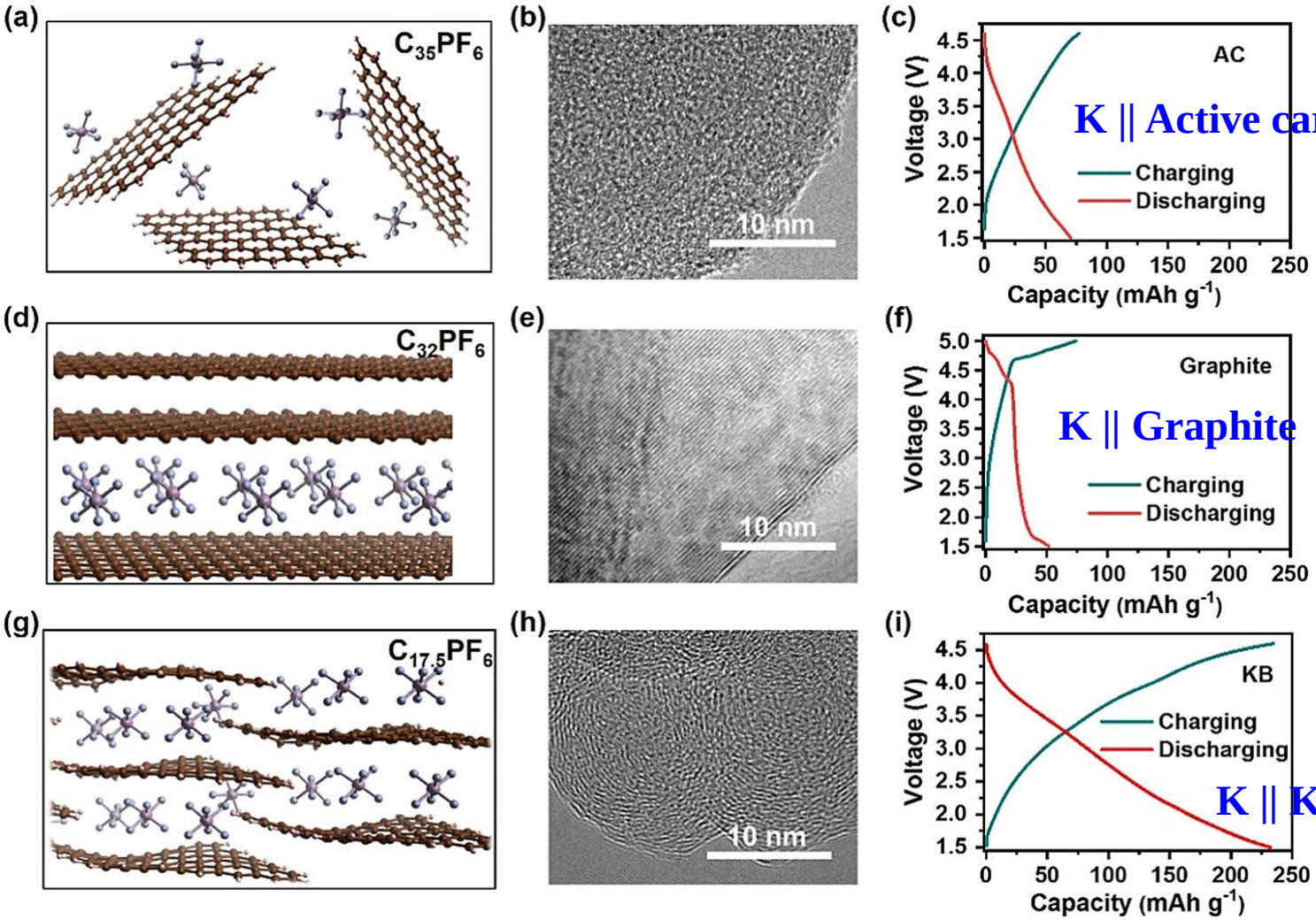
Insertion and Adsorption



The theoretical basis for building integrated devices. CV curve of K + -intercalation graphite anode at 0.5 mV/s at an operating potential window (OPW) of 0–3.0 V (orange solid line) and CV curve of PF 6 − -intercalation graphite cathode at 0.5 mV s − 1 at an OPW of 3.0–5.0 V (olive solid line); CV curve of K^+-absorption on AC at 5 mV/s at an OPW of 1.5–3.0 V (orange dotted line) and the CV curve of PF_6^--absorption on AC at 5 mV/s at an OPW of 3.0–4.5 V (olive dotted line). (c) Schematic of the electrochemical stable windows (SWs) and the electrochemical unstable windows (UWs) of 0.8 M KPF_6 in EC/DEC (1/1, v/v) based on activated carbon (AC) and graphite. The solid electrolyte interface (SEI) film forms in the region of 0–0.8 V versus Li/Li^+ .

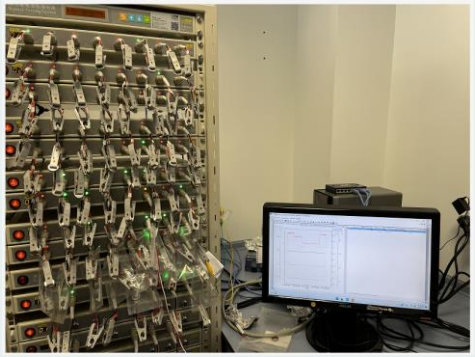
Samuel M. Fehr et al. ***Energy Storage Materials*** *34 (2021) 356–364*

Graphite Insertion/Adsorption

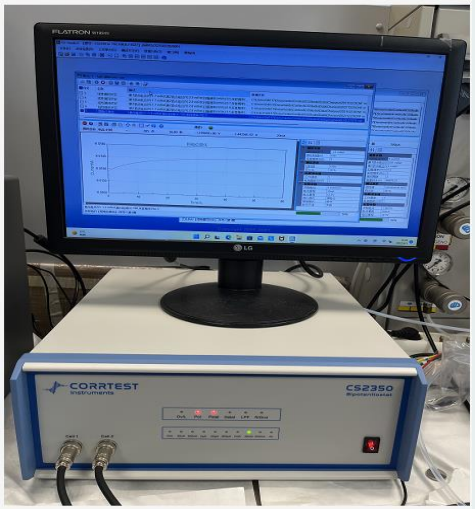


Yang K, et al. **Angew. Chem. Int. Ed.** *2021, 60, 6326-6332.*

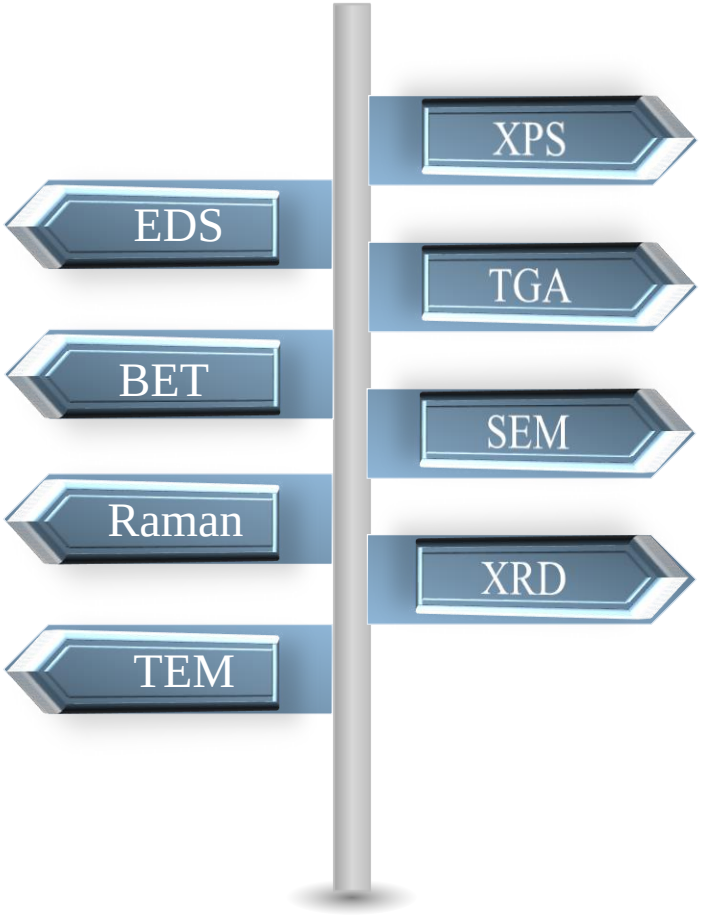
Characterization



Neware battery text system



Correst electrochemical Workstation

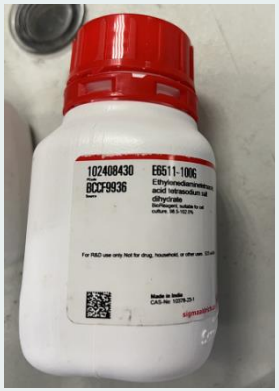


Material Characterization Facilities.

Materials and method

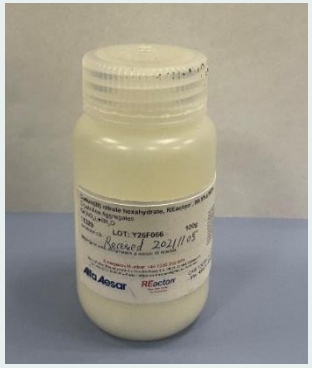
Raw materials

EDTA

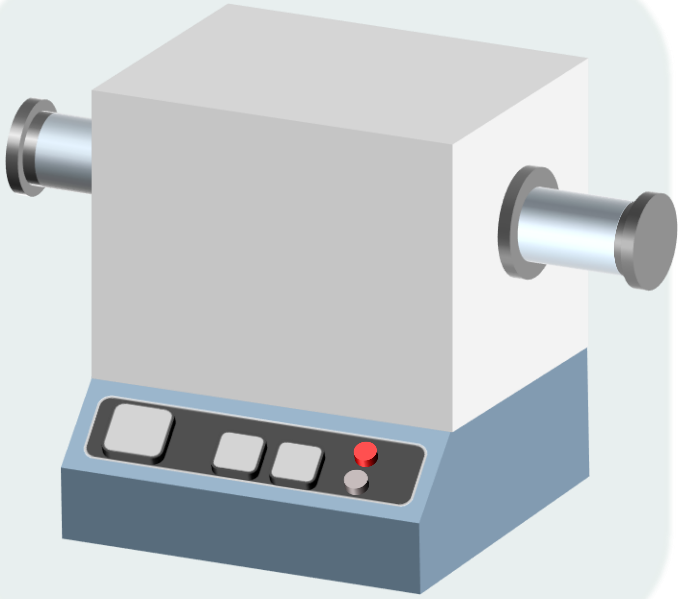


+

$Co(NO_3)_2$



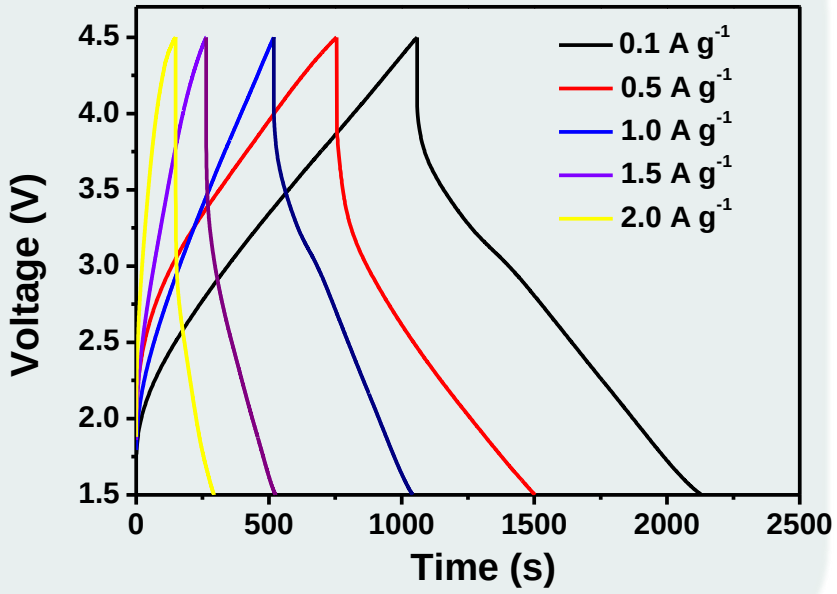
Preparation method



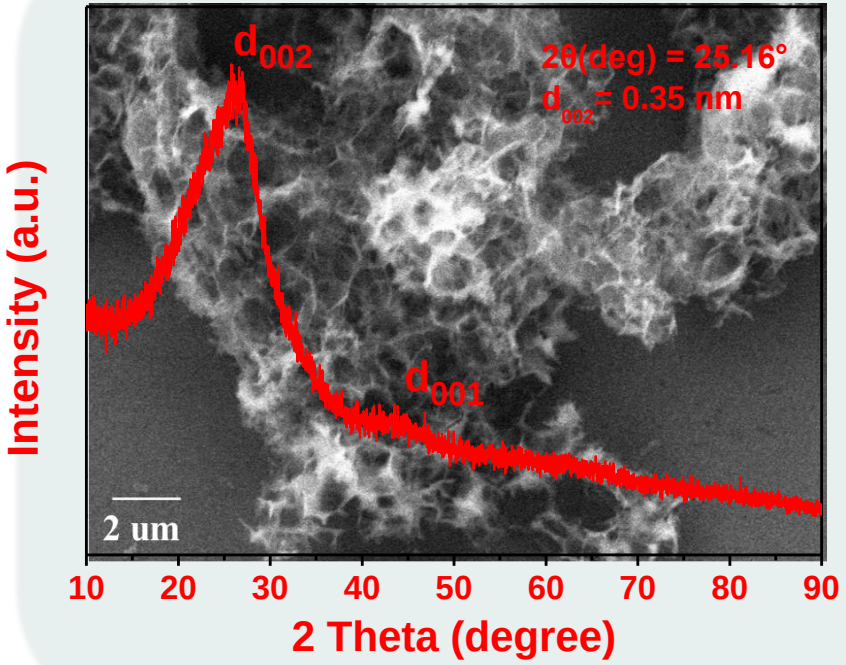
Cobalt Catalyzed Graphitization Carbon

Preliminary work

3D highly graphitized porous carbon



Hard carbon|| 3D highly graphitized porous carbon



Next Plan:

1. Extended the double-carbon structure energy storage device;
2. Increase power density

Working plan

This project is planned to take place from October 2021 until the end of April 2024.

The chronogram of the project is shown as follows:

Time schedule.

Literature review										
WP1.Initiating to design the experimental device										
WP2. Preparation of graphitization carbon anode material										
WP3. Preparation of graphitization carbon cathode material										
WP4. Design of electrolyte system suitable for DCESD system										
WP5. Development of new DCESD system.										
WP6. Summarize all data into papers.										

Thanks for your attention!