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High Performance Carbon Nanofiber Supercapacitor Electrode with Tuned Porous Structure

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A high-performance symmetrical supercapacitor device based on carbon nanofibres with optimized linear tube structure



Sanket Bhoyate, P. K. Kahol and Ram Gupta



Topics

- Introduction
- Process background
- Characterization and properties
- Electrochemical properties
- Applications
- Summary
- References

Introduction

► Energy conservation and its use

Energy Production

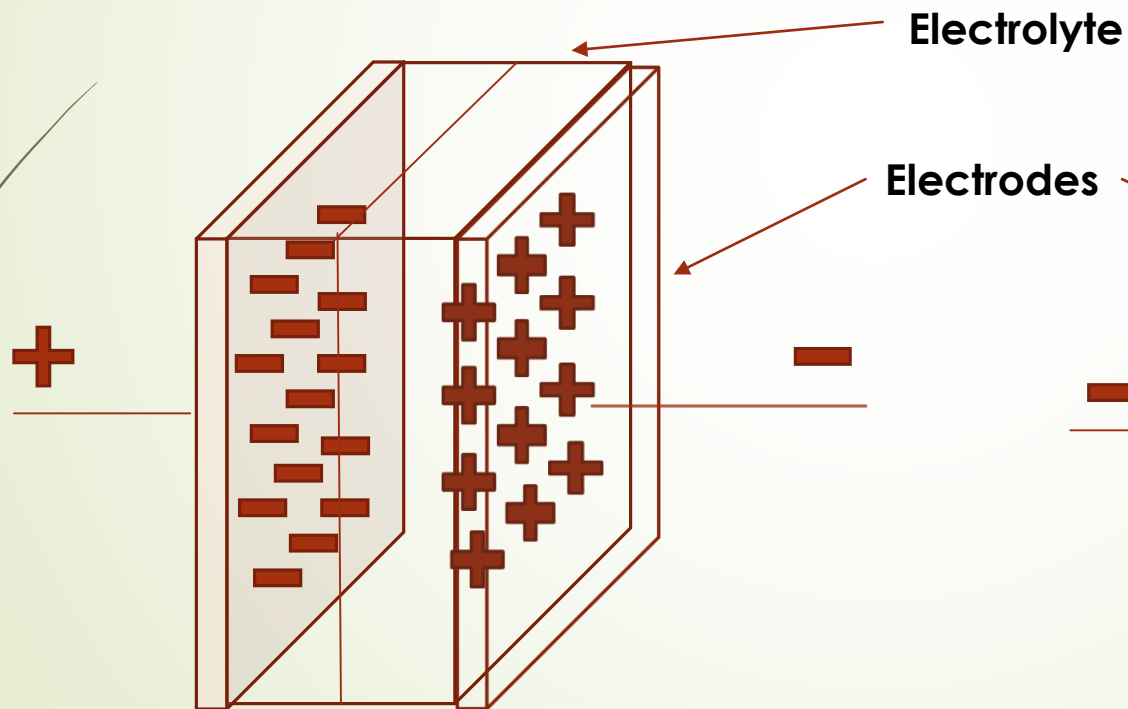


Stored local energy



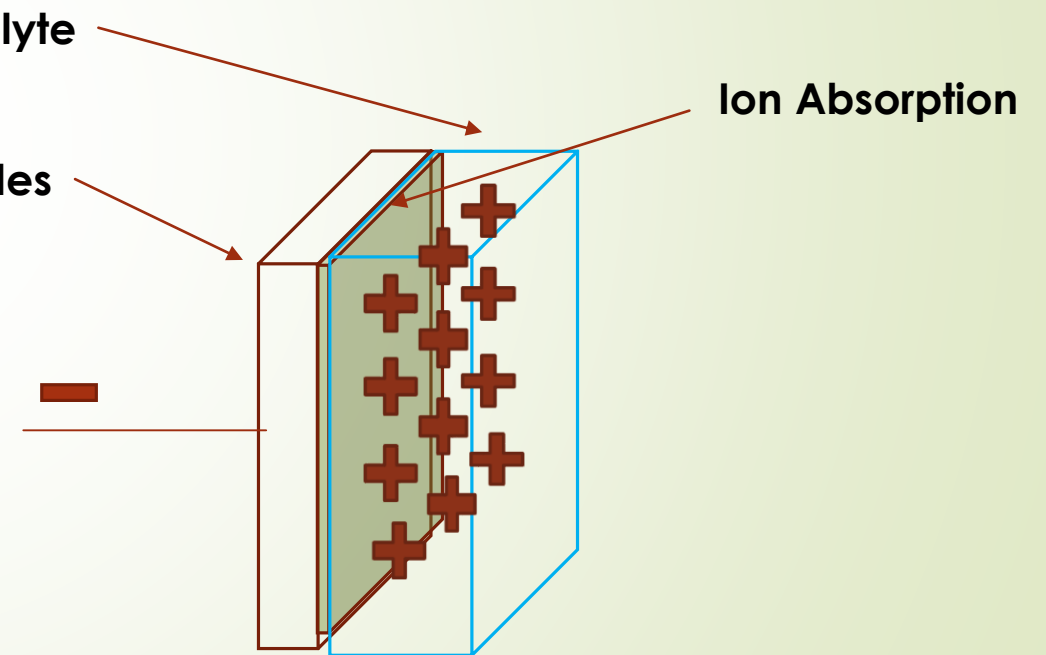
Supercapacitors

1) Electric Double Layer



EDL is 0.6-1 nm thick

2) Faradic Reaction



Charge Layer is nm to μm thick



Overall Process



Step 1

- 10% PAN Solution in DMF
- 10% PAN-PS (1:1) in DMF



Step 2

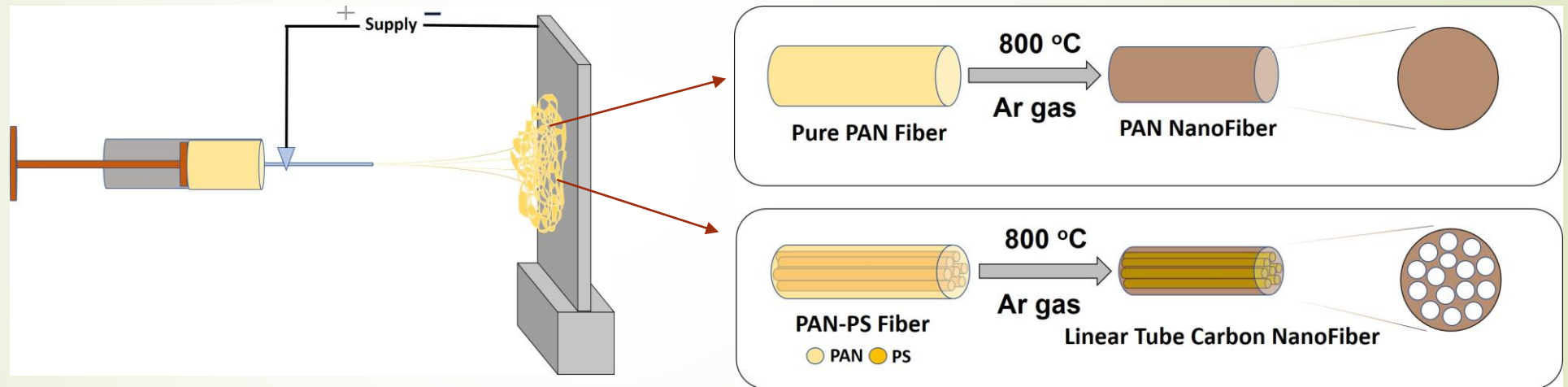
- Electrospinning of the Fibers
- Carbonization at 800°C



Step 3

- Make an electrode by dip-coating Ni-Foam
- Electrochemical characterization

Electrospinning

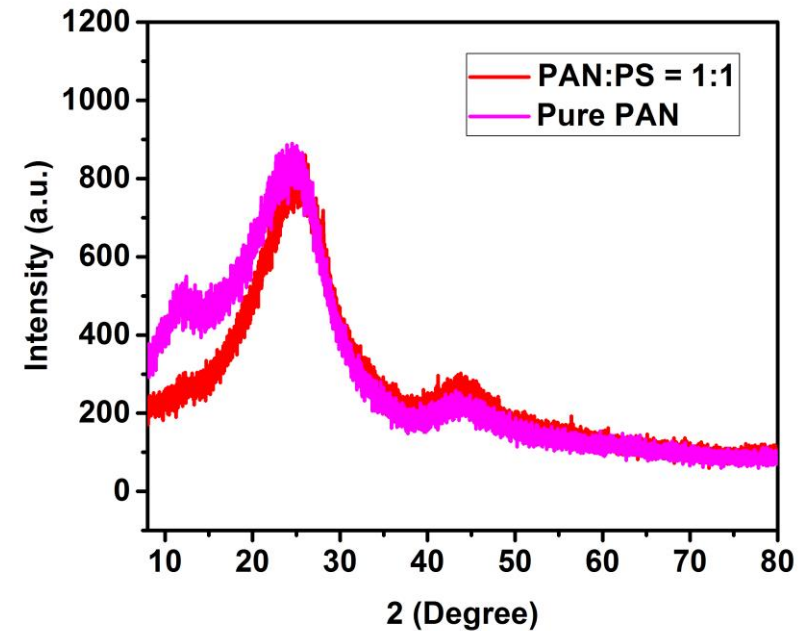
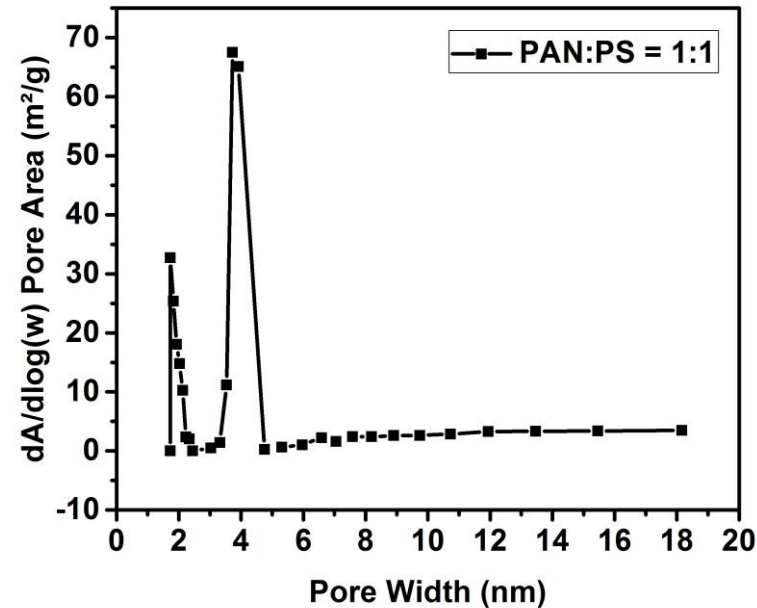


Linear Tube Carbon Nanofiber (LTCNF)

Electrospinning



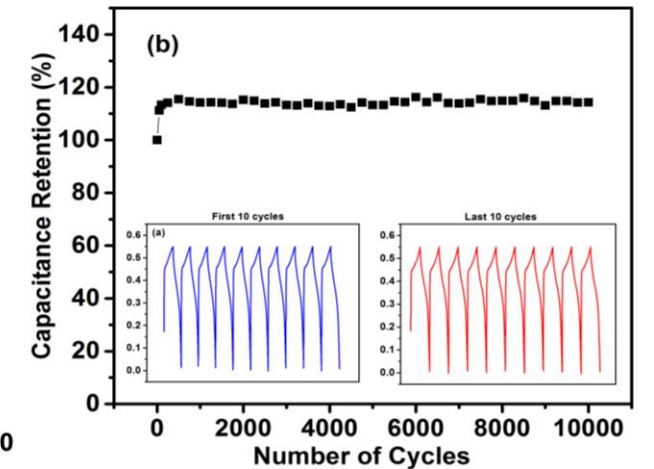
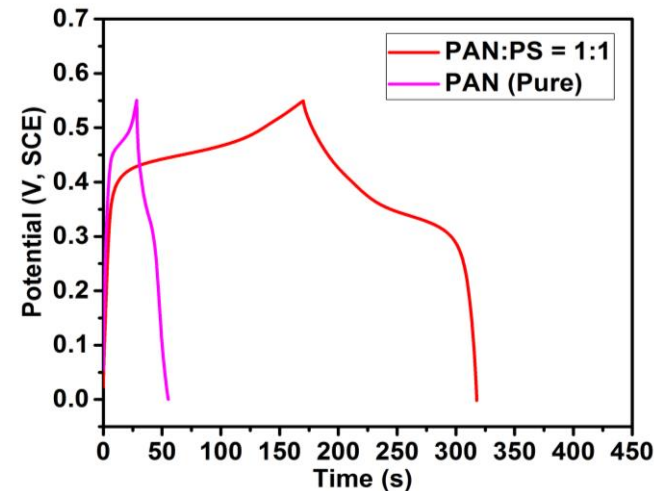
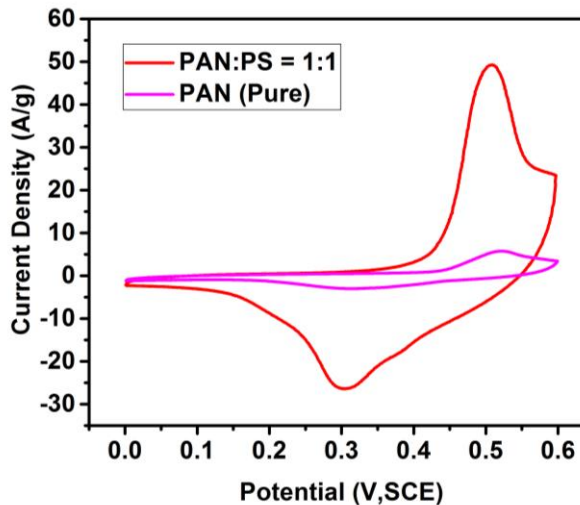
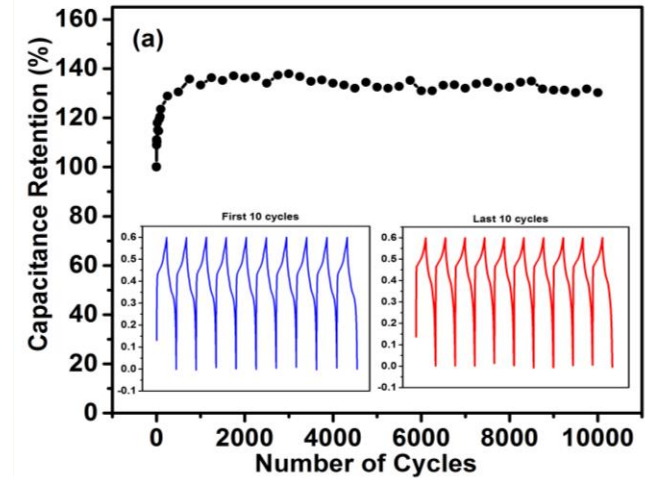
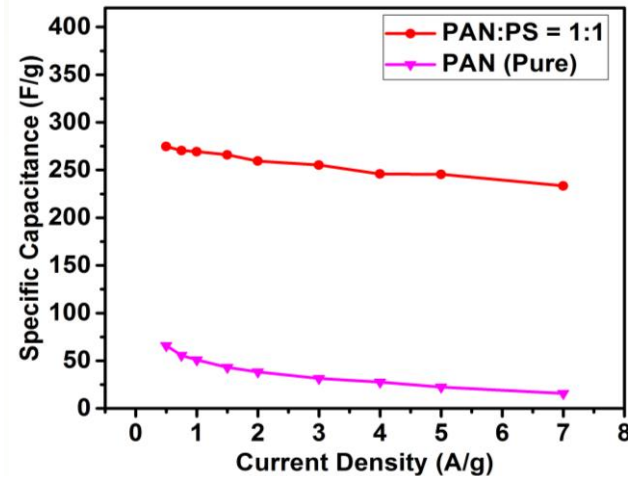
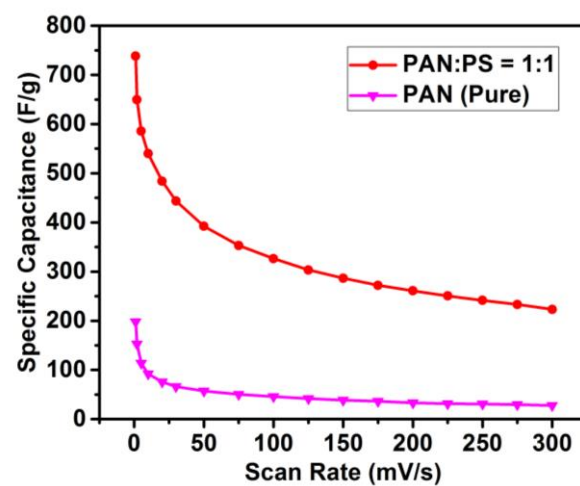
Characterization of LTCNF



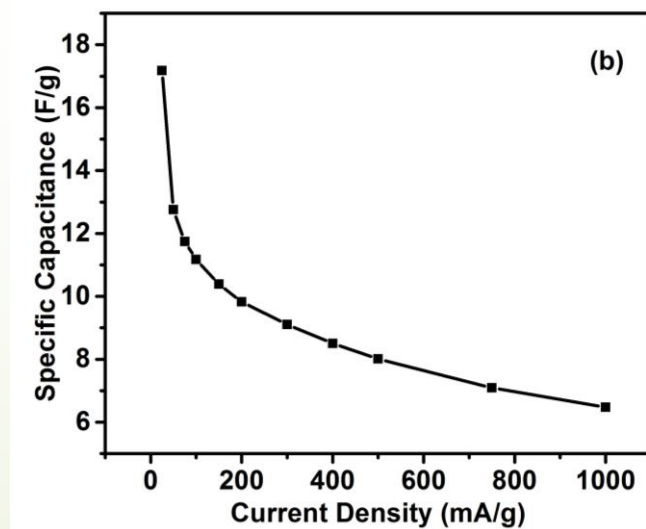
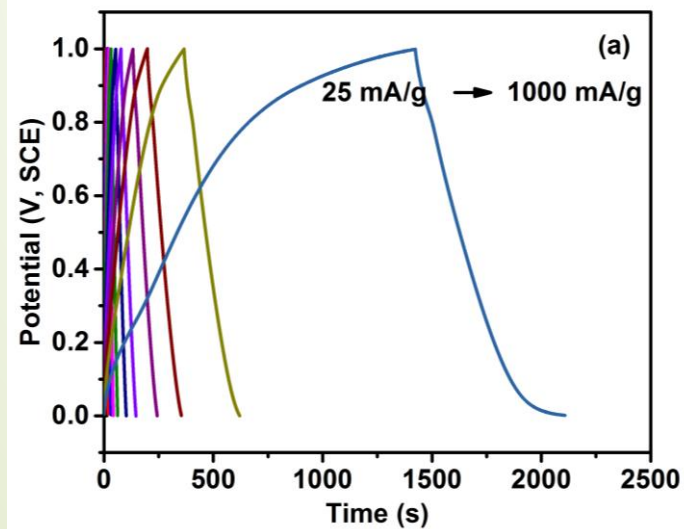
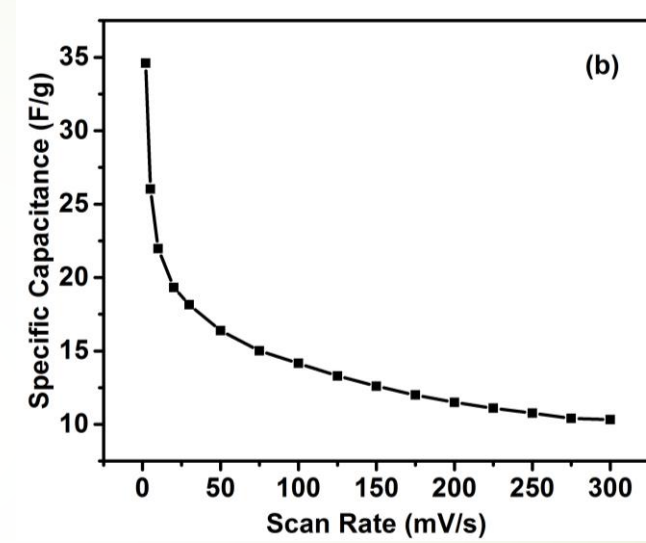
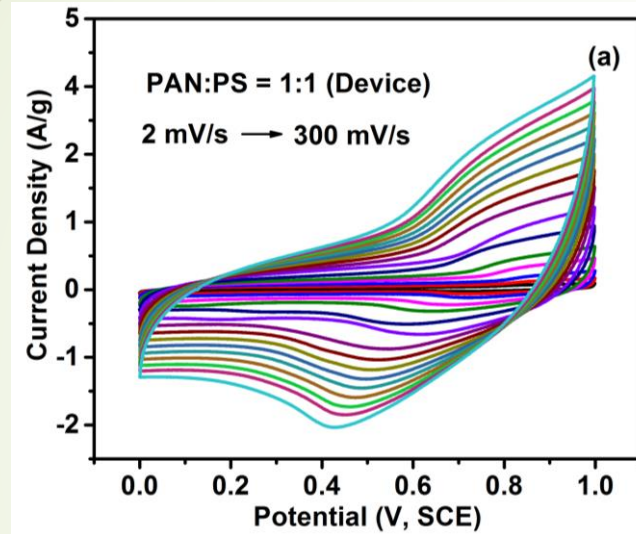
BET Surface area = $\sim 86 \text{ m}^2/\text{gm}$

Electrochemical Measurements

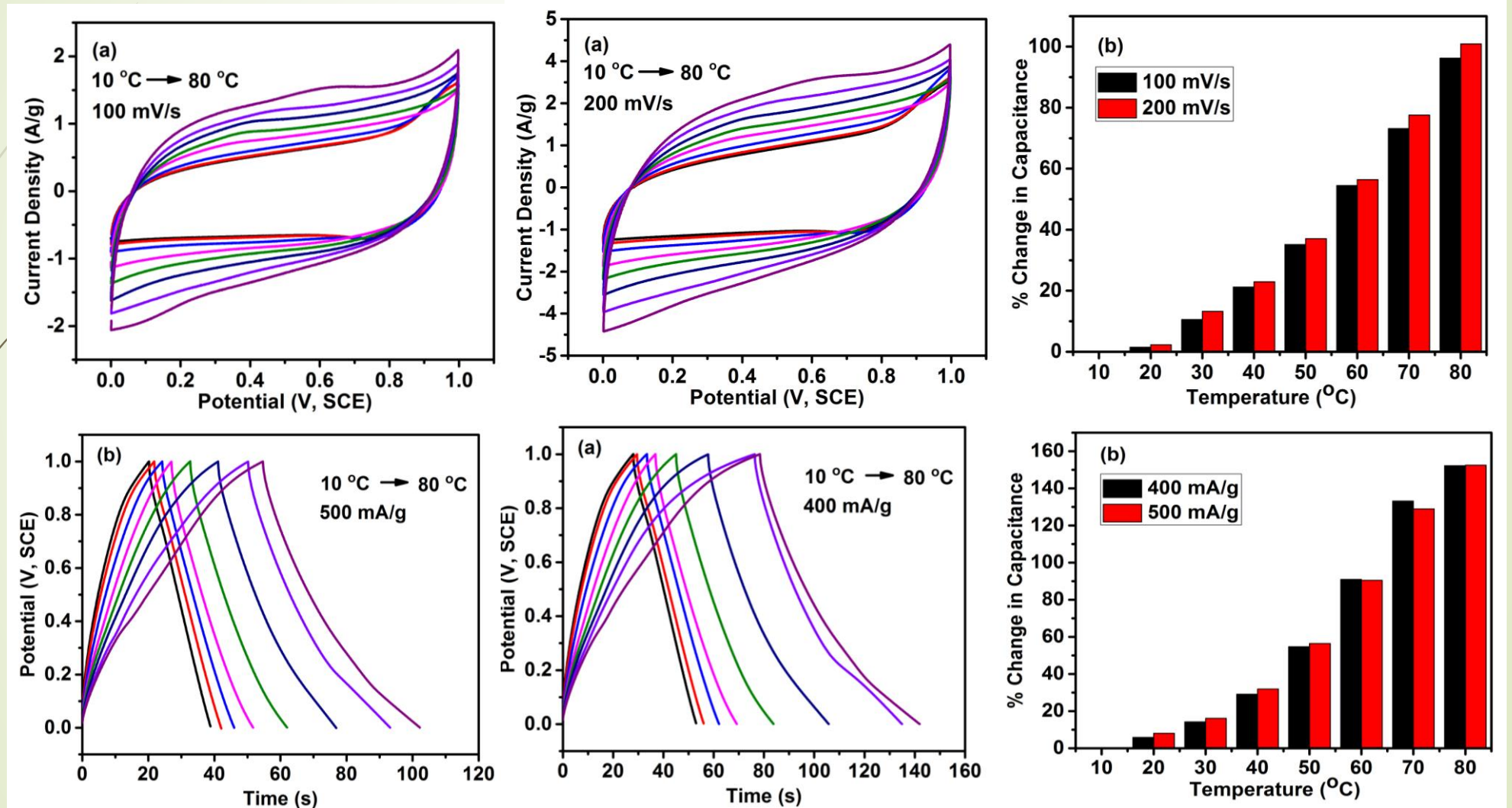
CV and CD curves



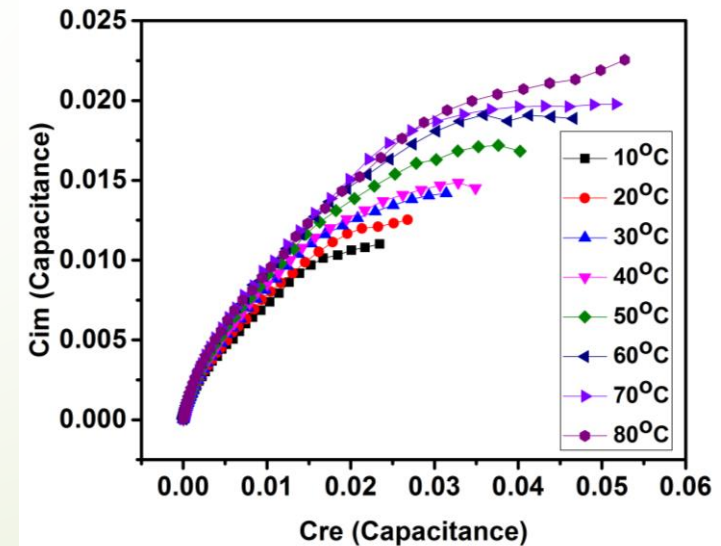
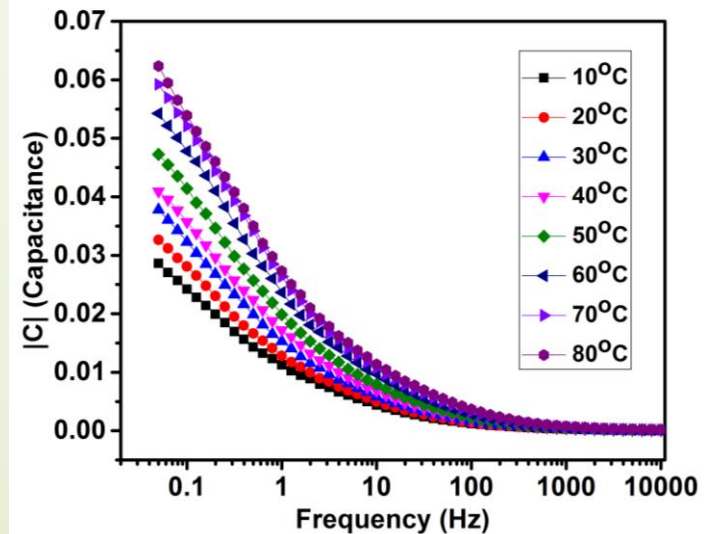
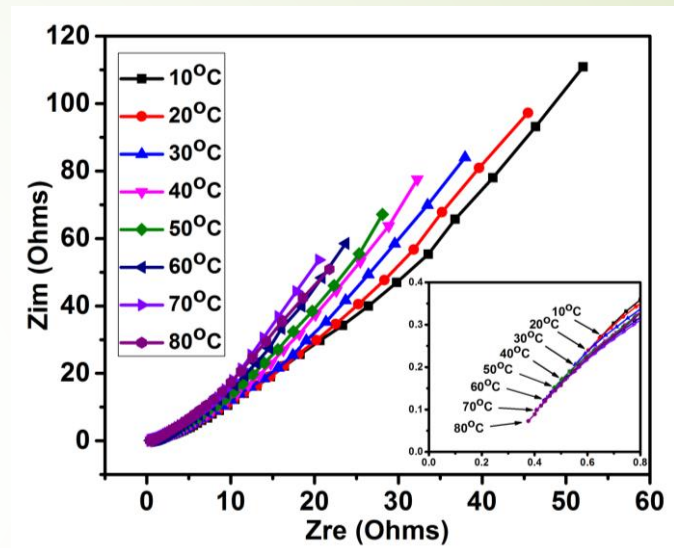
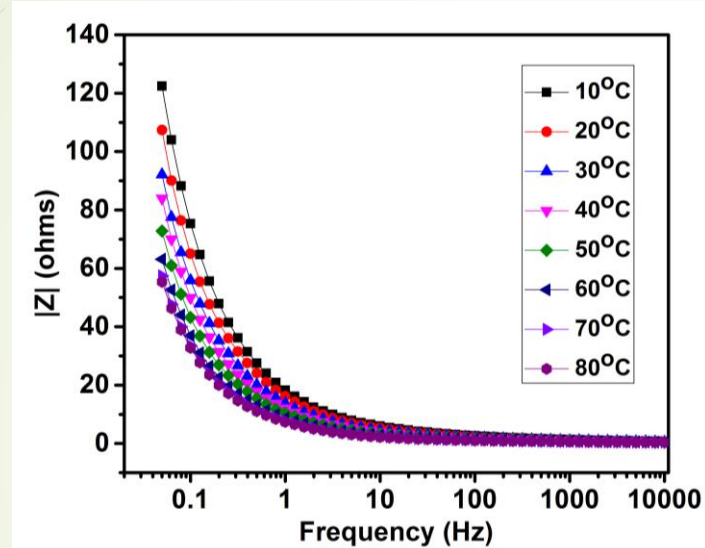
Device Study



Device Study




EIS for supercapacitor device



Applications of SC





Summary and future aspects for research

Future of Research

- Introduction
- How to prepare Carbon nanofibers by electrospinning
- Charging with various redox materials to obtain high performance effects.
- Electrochemical device fabrication for electrode in 3 electrode system
- Electrochemical measurements for SC device
- Effect of temperature on device
- EIS results
- Applications



References

- 1) Flexible solid-state electrochemical supercapacitors
By- Peihua Yang, Wenjie Mai
Nano Energy(2014) 8, 274–290
- 2) Images from introduction and application slide are from
Google images

Thank You