

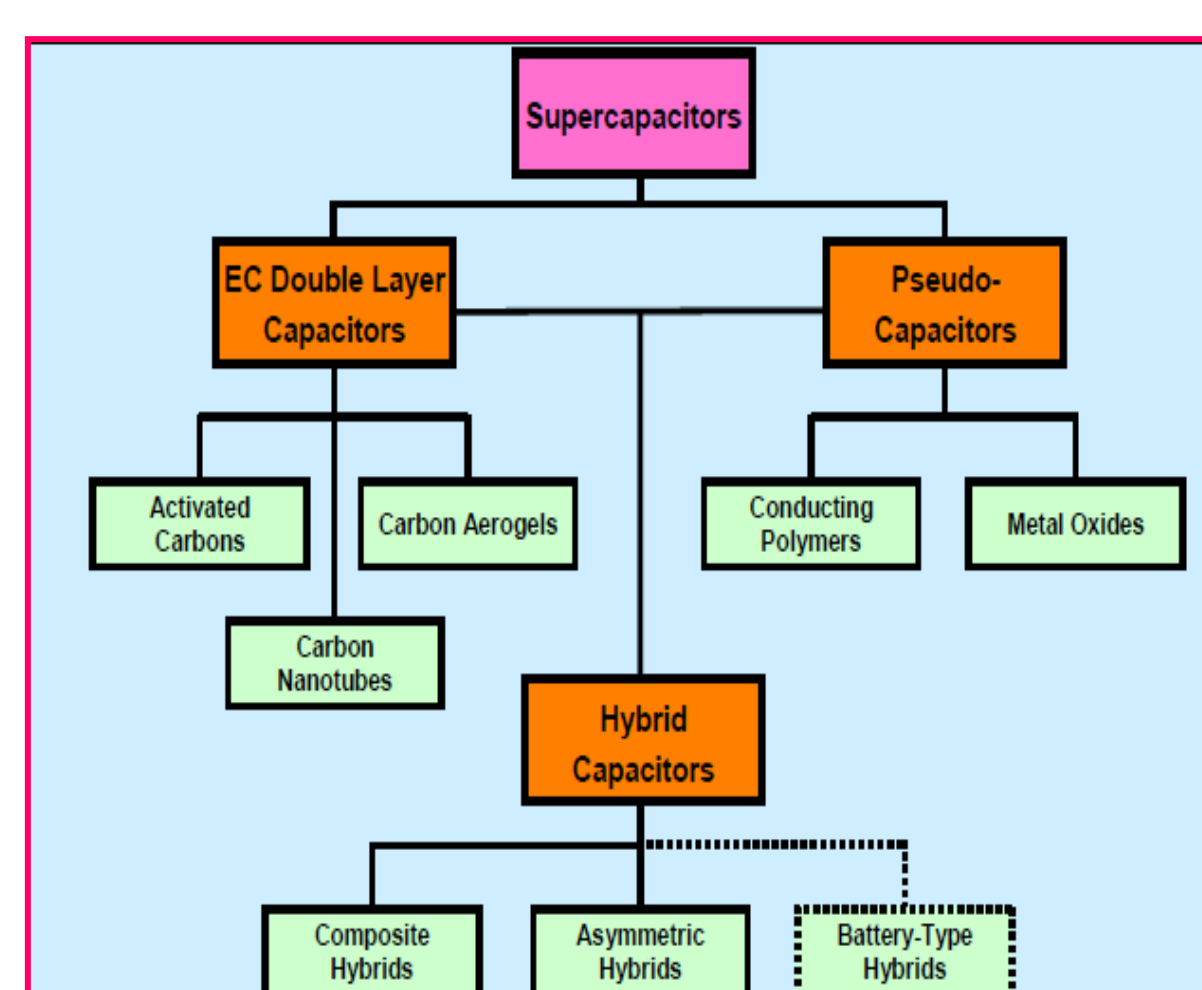
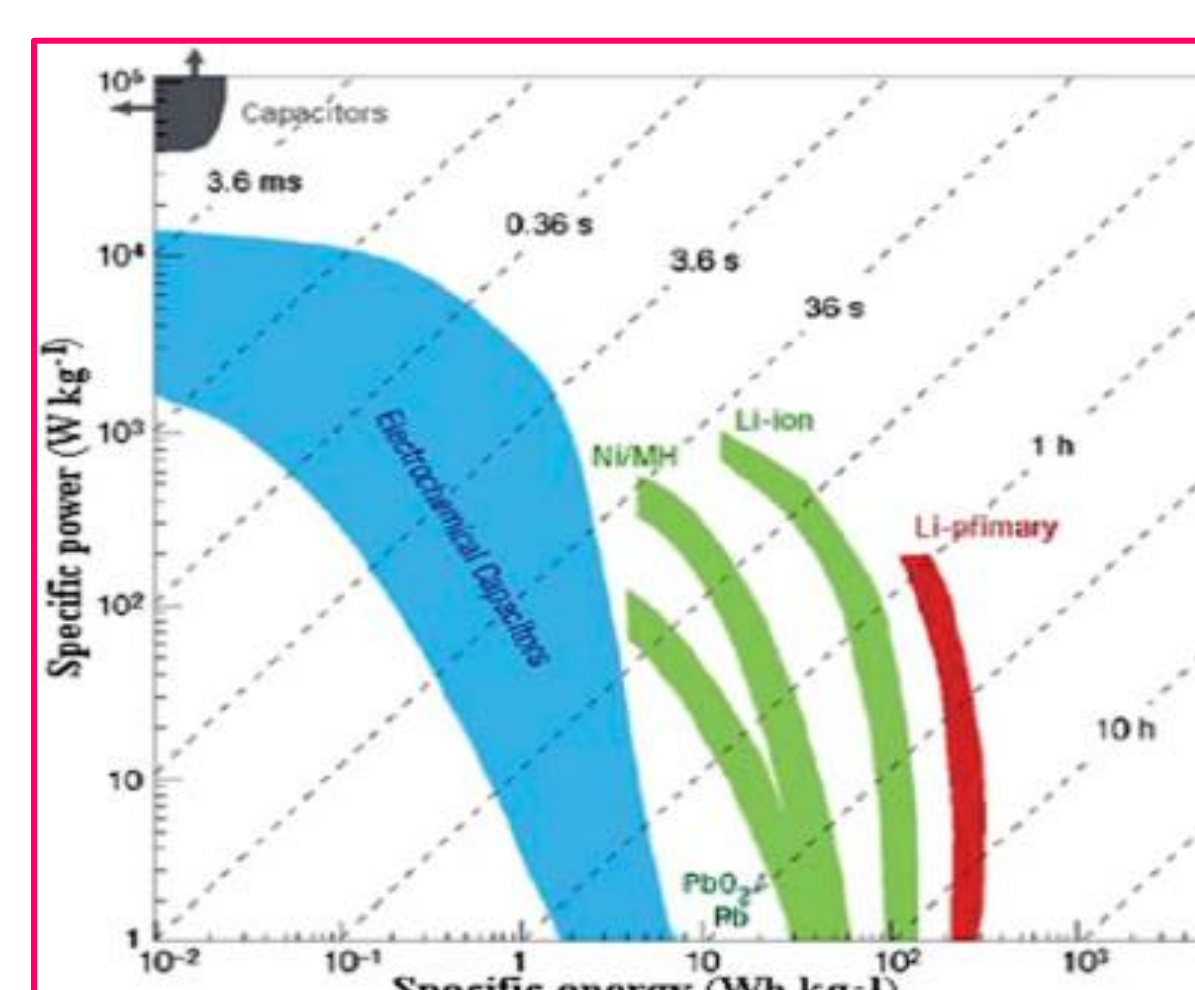
Facile Synthesis of Hierarchically Porous Carbon Tubes Inherently Doped with Nitrogen, Oxygen and Iron oxide Nanoparticles as Supercapacitor Electrodes



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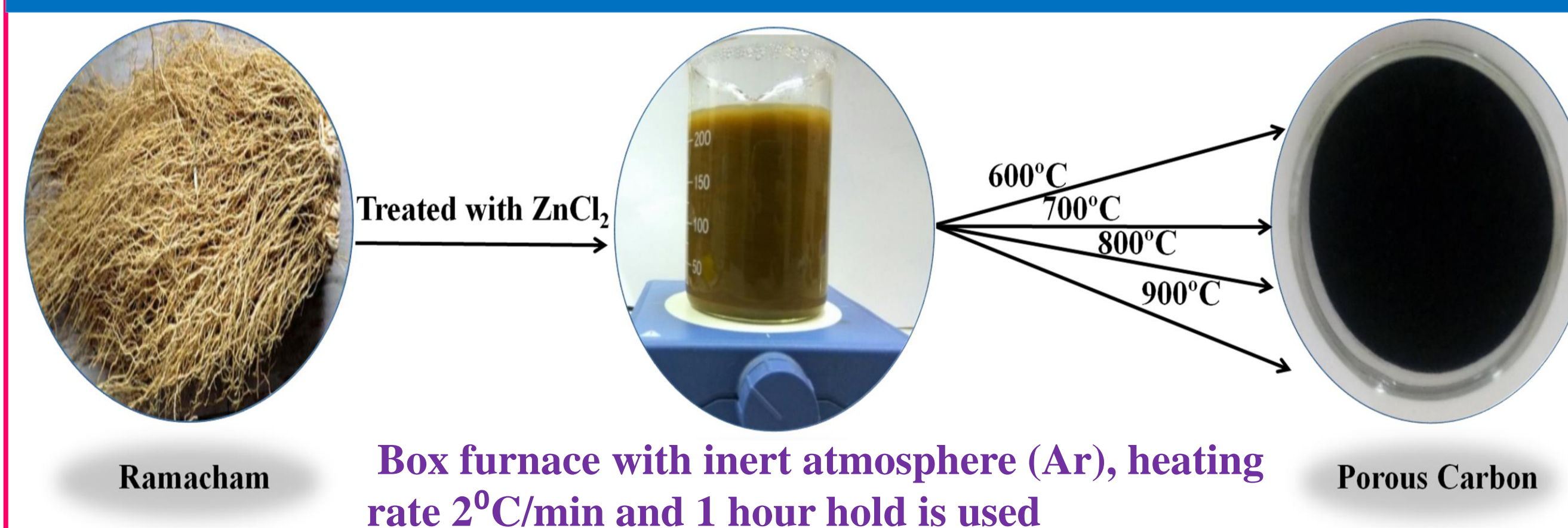
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Introduction



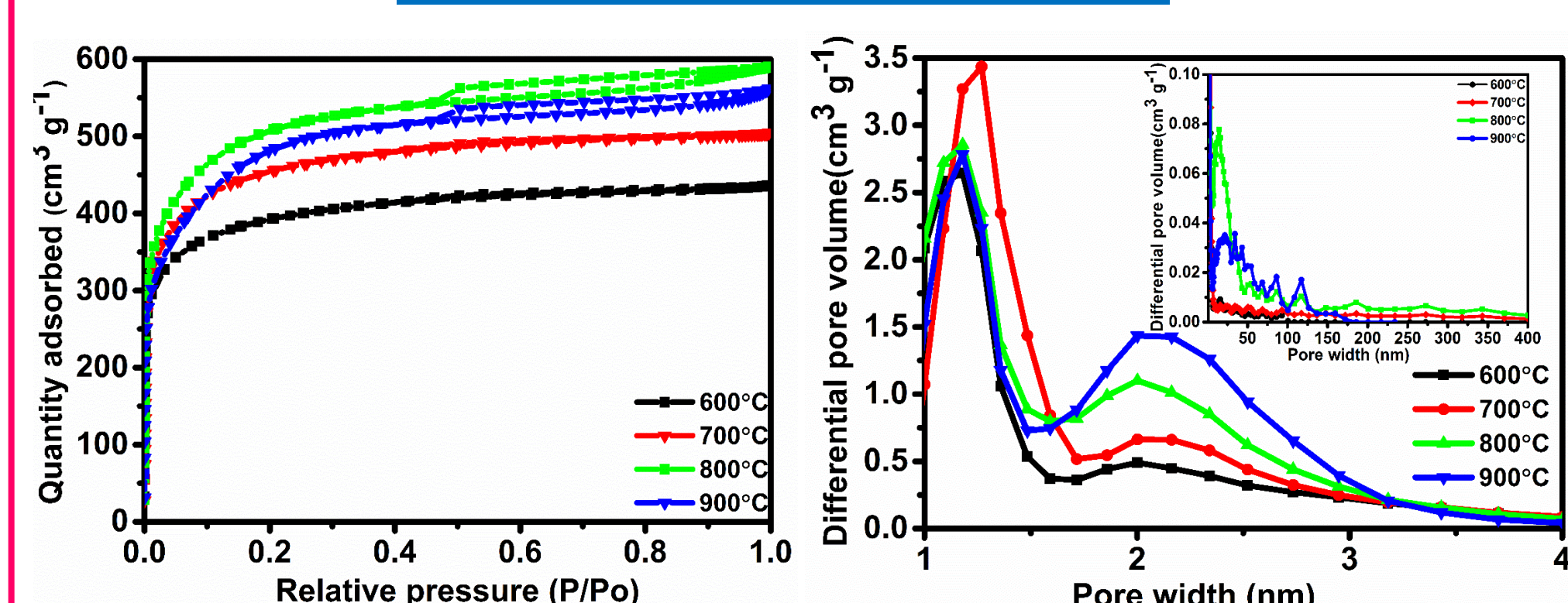
Experimental

Preparation of Hierarchical Porous Carbon Tubes (HPC)

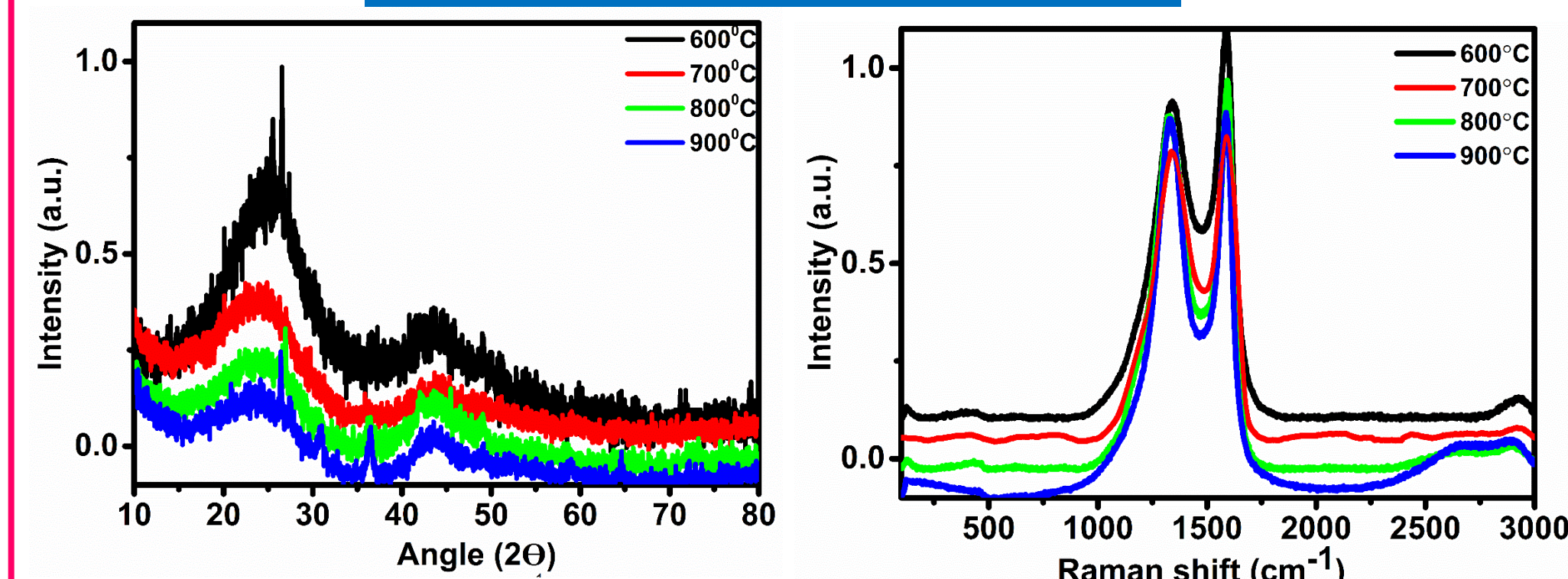


Results and Discussion

Surface area analysis

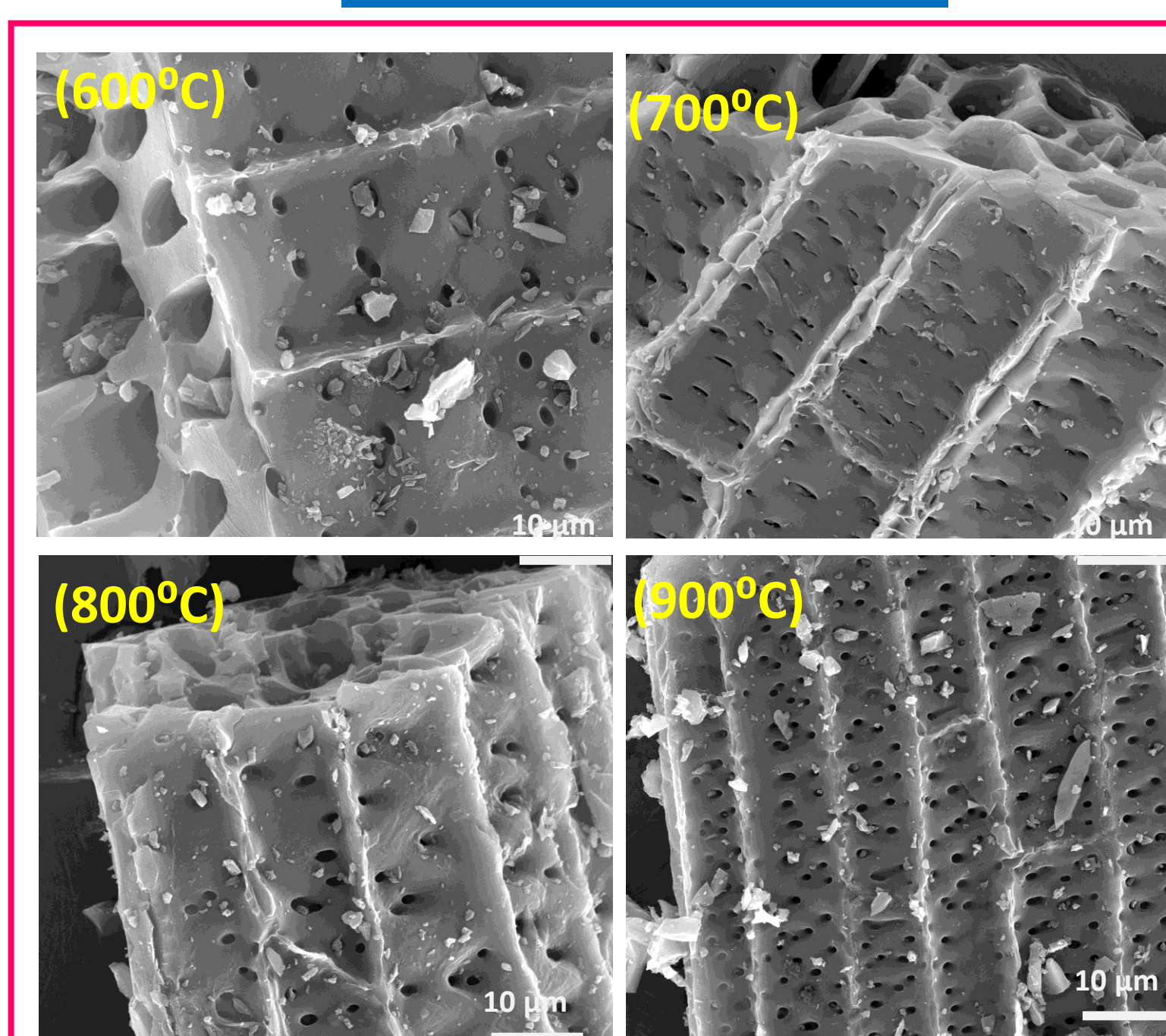


XRD & Raman analysis



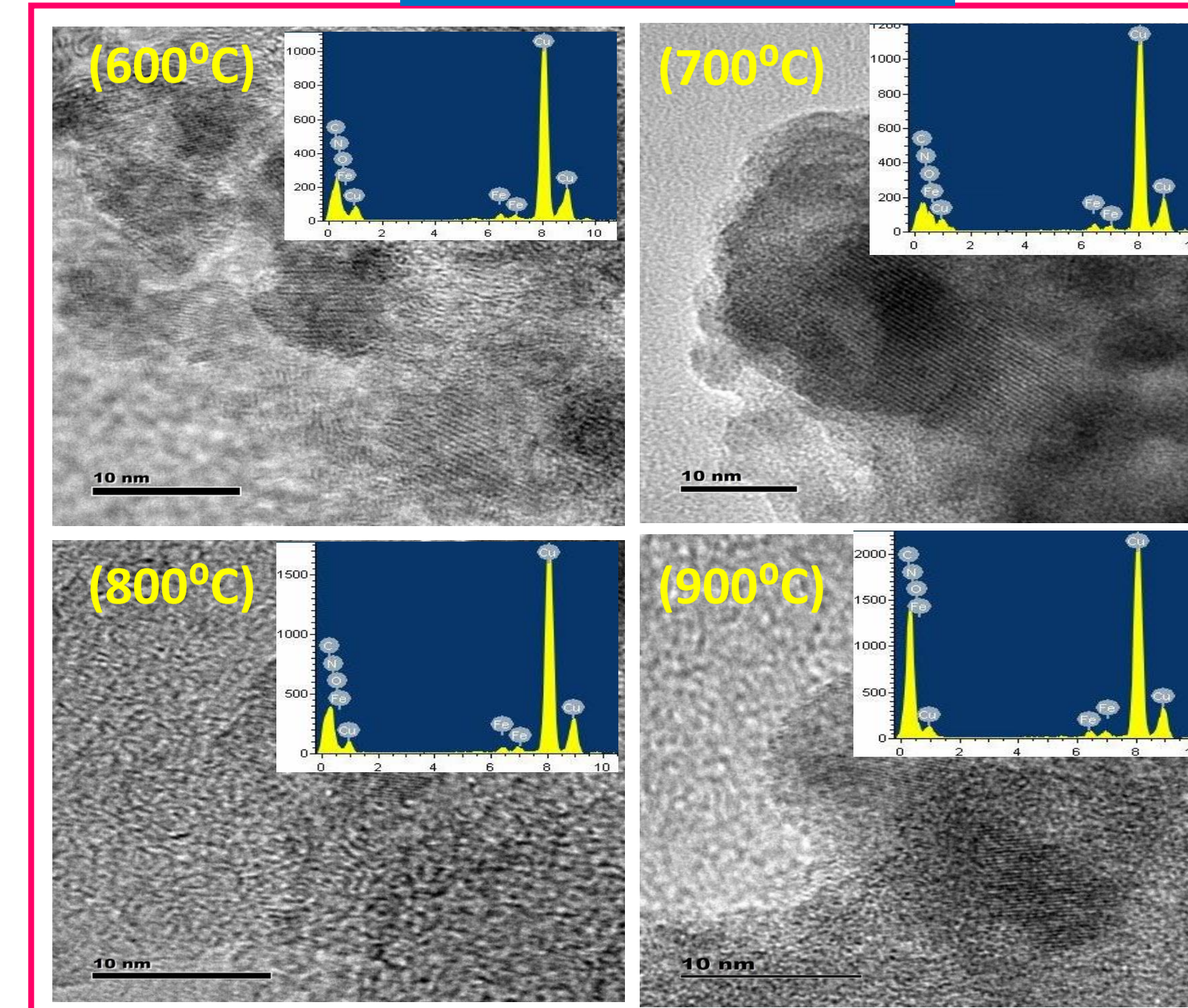
- The maximum BET surface area 1879 m² g⁻¹ and pore volume is 0.91 cm³ g⁻¹
- When the pyrolysis temperature is raised, induce disorder structure
- Increase in I_D/I_G ratio support the raise in the content of disorder structure.

SEM analysis

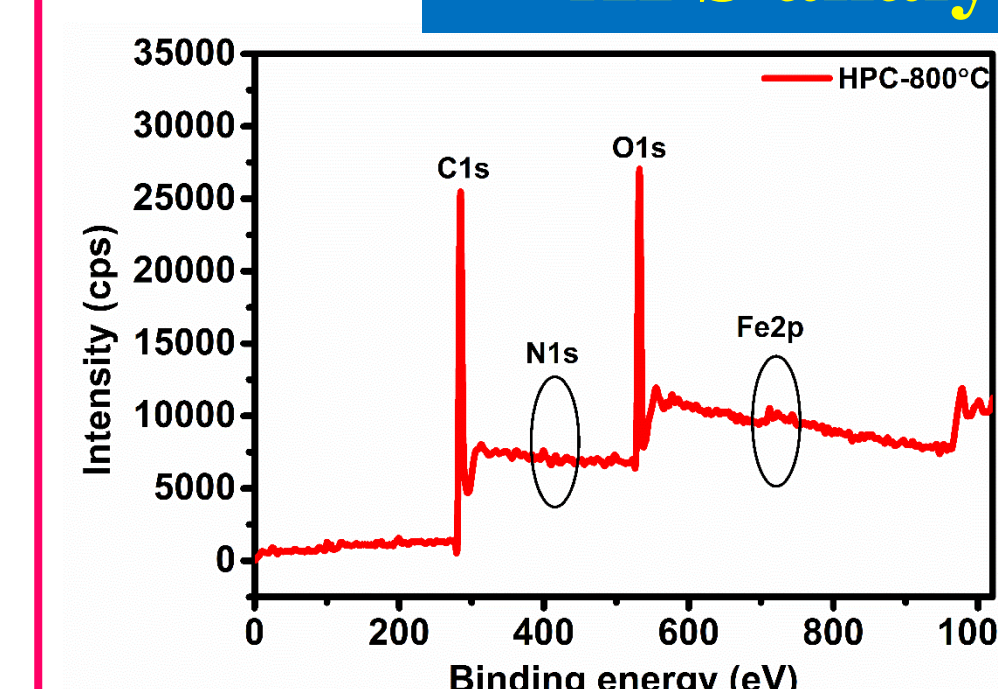


- Micro tube like structure with inter connected networks
- The morphologies of HPC demonstrated by the presence of well developed porous structure
- TEM-EDS analysis confirms the presence of N, O and Fe in the carbon molecular Skelton

TEM analysis



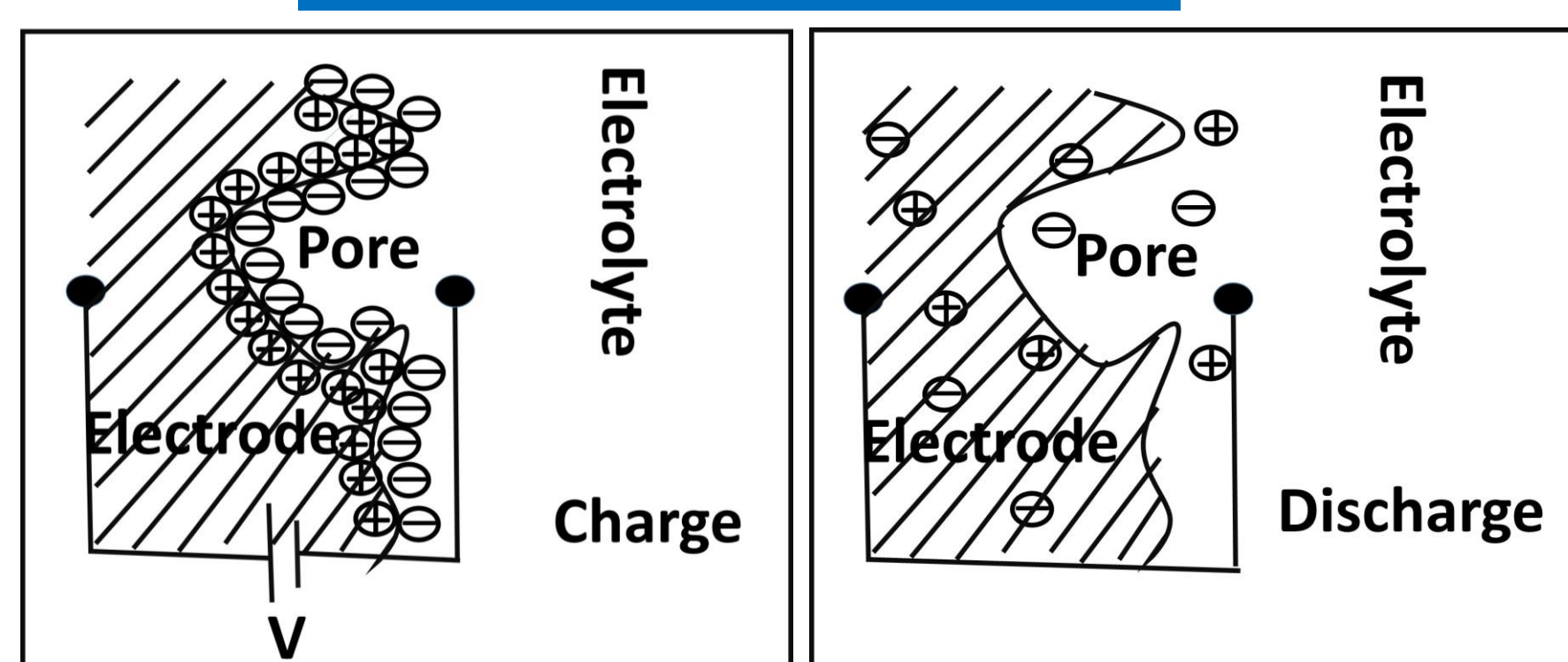
XPS analysis



- Chemical states of the elements
- C1s - 283.7 eV
- N1s - 400 eV
- O1s - 533.1 eV
- Fe2p - 710 eV

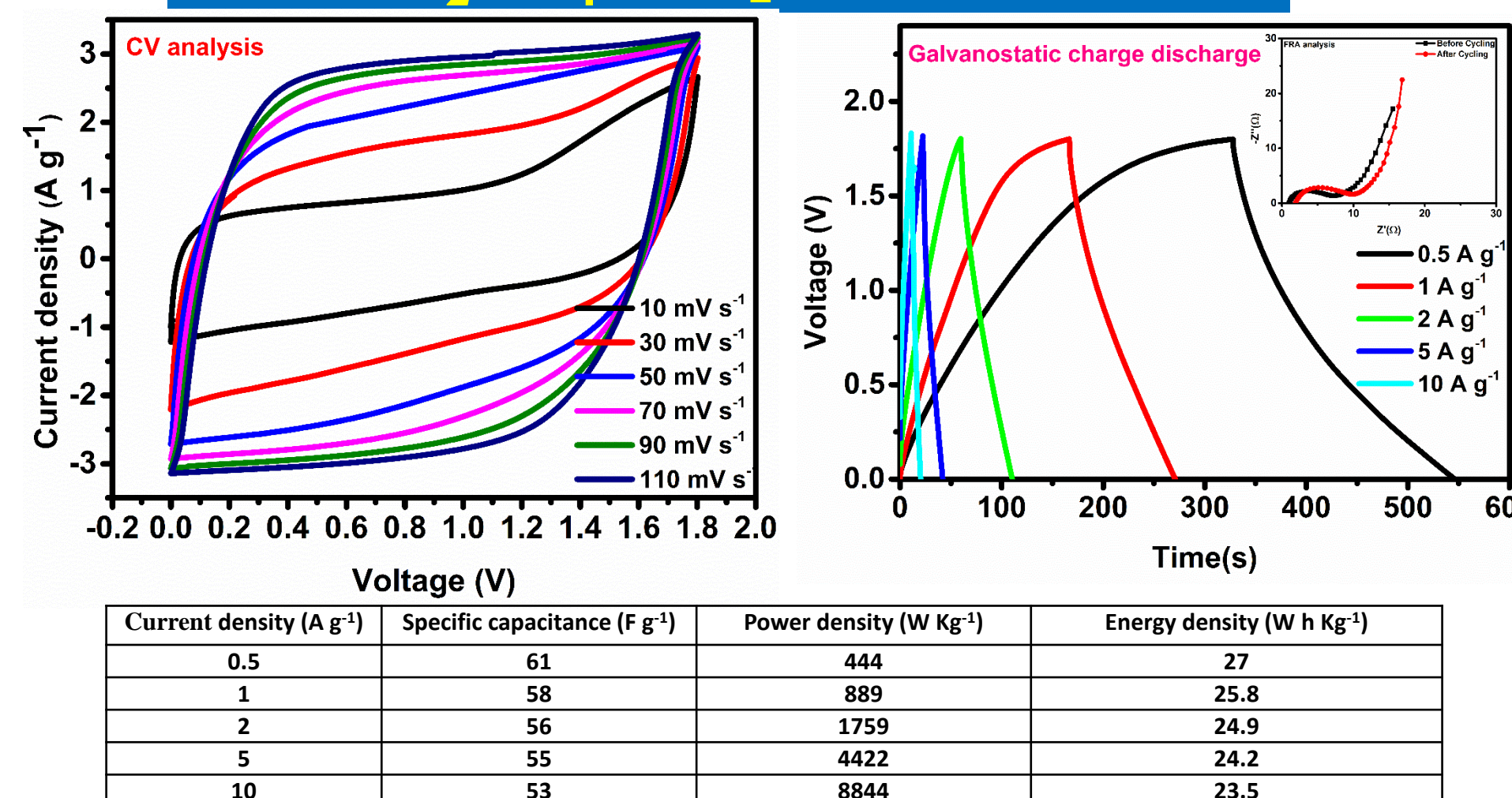
Electrochemical Characterization

Mechanism for EDLC

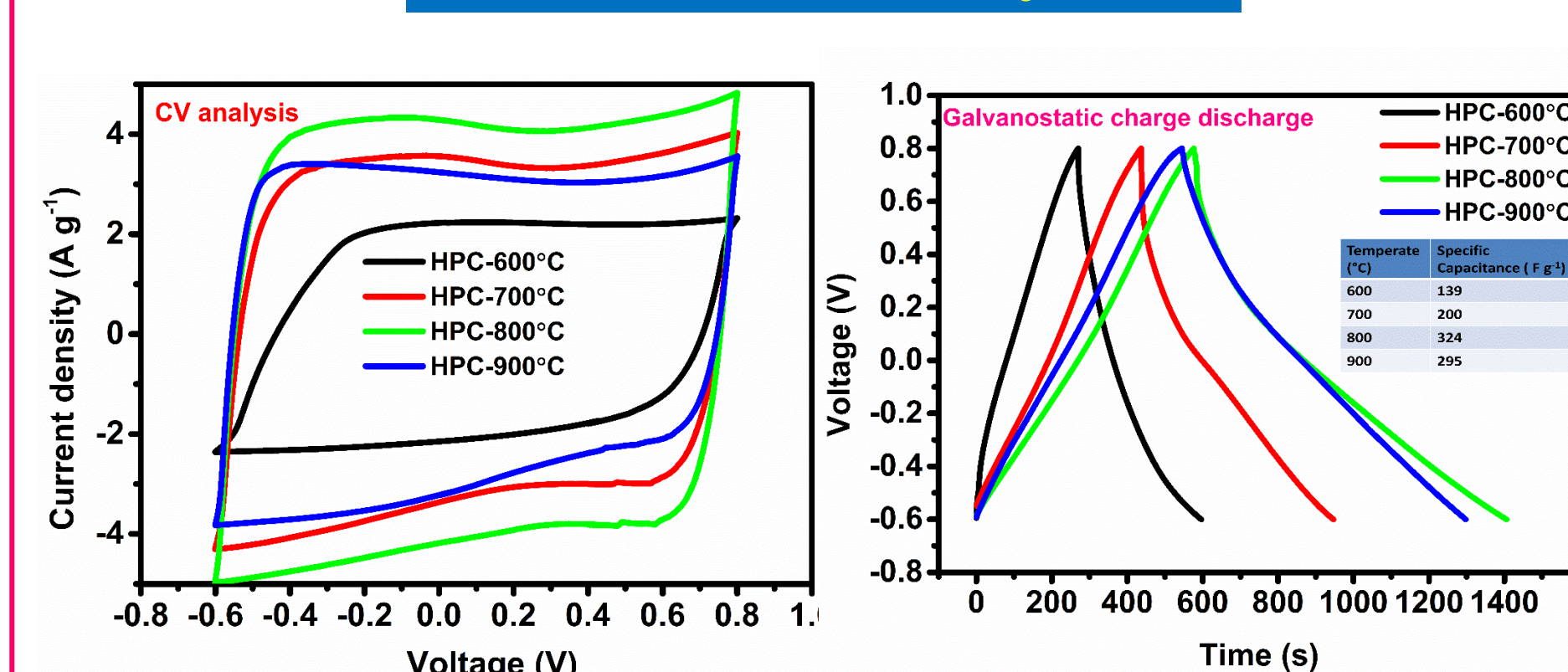


Two electrode system

1M Na₂SO₄ in aqueous solution

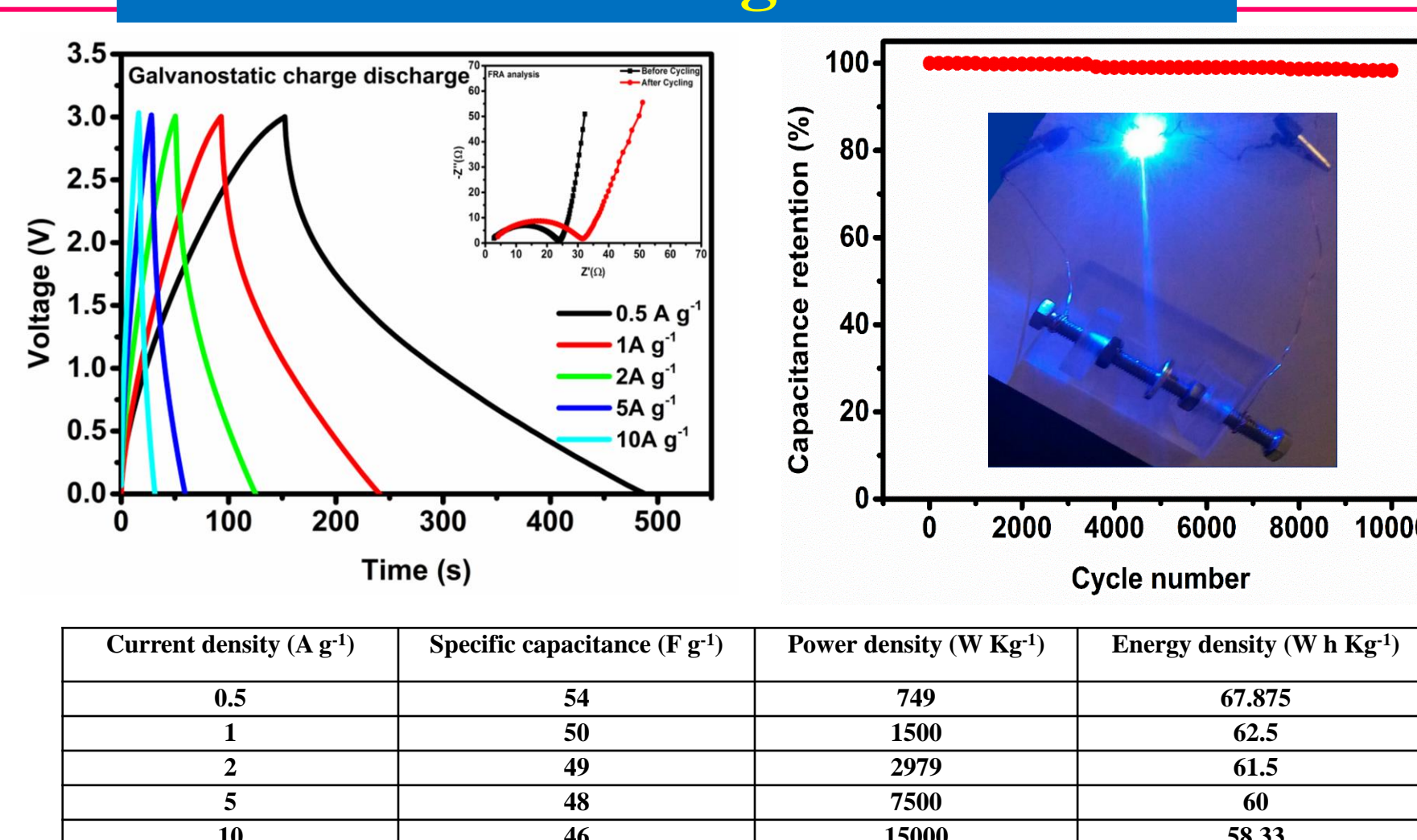


Three electrode system



- 1M Na₂SO₄ as electrolyte with Ag/AgCl as reference electrode and Pt mesh as counter electrode
- Selected HPC-800°C for further evaluation like fabrication of symmetric supercapacitor

1M LiTFSI in organic solvent



Conclusion

- Heteroatoms doped a high surface area carbon is prepared from ramacham by ZnCl₂ activation method
- HPC-800°C shows the maximum specific capacitance 324 F g⁻¹ at a current density of 0.55 A g⁻¹
- HPC-8/HPC-8 symmetric supercapacitors is fabricated, specific capacitance 61 F g⁻¹ with 1M Na₂SO₄ & 54 F g⁻¹ with 1M LiTFSI
- The device exhibited a maximum energy density of 67.8 Wh Kg⁻¹ with a maximum power density of 15000 W Kg⁻¹
- ~98% capacity retention after 10,000 cycles at a current density of 10 A g⁻¹

References

- H. Wang, H. Yi, X. Chen, X. Wang, J. Mater. Chem. A, 2 (2014) 3223-3230.
- T. Kesavan, R. Aswathy, I. Arul Raj, T. Prem Kumar, P. Ragupathy, ECS J. Solid State Sci. Tech. 4 (2015) M88-M92.

Acknowledgement

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