CHRIST
(DEEMED TO BE UNIVERSITY)
BANGALORE · INDIA

Notice for the PhD Viva Voce Examination

Ms Elma Elizaba Mathew (Registration Number: 1942093), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Wednesday, 14 May 2025 at 2.00 pm in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Defect Induced Surface Engineering of Carbon Derivatives and its Effect on Energy Storage Devices**
Discipline	:	**Physics**
External Examiner – I	:	**Dr K Thangaraju** Professor Department of Physics National Institute of Technology Warangal - 506004 Telangana
External Examiner - II	:	**Dr Prasanth Raghavan** Professor Department of Physics Cochin University of Science and Technology Kochi - 682022 Kerala
Supervisor	:	**Dr Manoj B** Professor Department of Physics and Electronics School of Sciences CHRIST (Deemed to be University) Bengaluru 560029 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 07 May 2025

ABSTRACT

An intense surge in the demands of the increasing population has resulted in a significant energy crisis and poor waste management. This has led to the degradation of the environment, ultimately affecting sustainable development. Fossil fuels, being one of the biggest contributors to energy consumption have also impacted global warming and drastic changes in the climate. At the same time, the rapid depletion of these fossil fuels has initiated the dire need to shift our path toward regenerative energy sources like solar, hydro and wind energy. Nevertheless, these renewable energy sources are purely dependent on environmental conditions and this is when an alternative system to store energy is required to meet the ongoing energy crisis. In particular, Supercapacitors, which connect the gap between conventional batteries and capacitors, offer promising solutions as efficient energy storage systems for their ability to store energy electrostatically by providing high power density due to their rapid charge-discharge cycles and longer operational cyclic stability. Their exceptional features are highly suitable for numerous applications from consumer electronics to electric vehicles.

The present work explores the valorization of carbon derivatives obtained from wood Charcoal and Carbon Black by tailoring their inherent defects to fabricate electrodes for storage devices. While incorporating active and tunable oxygen functional groups provide active redox sites, doping with Nitrogen and Sulfur improved the surface area and conductivity of the system. Furthermore, these carbon derivatives were also subjected to co-doping with Nitrogen and Sulfur to improve their properties, especially in terms of higher energy densities and enhanced stability. The synergetic effects of both these heteroatoms have resulted in obtaining a sustained energy density even at higher power densities and longer cycle life. This development brings to light the prospects of valorizing these materials as competent and eco-friendly electrodes for energy storage applications.

Keywords: Supercapacitors, Energy Storage, Heteroatoms, Energy density, Power density, Cyclic stability, Carbon black, Charcoal

Publications:

1. **Elma Elizaba Mathew**, Manoj Balachandran, "Crumpled and porous graphene for supercapacitor applications: a short review." *Carbon Letters* (2021): 1-19. *https://doi.org/10.1007/s42823-021-00229-2*
2. **Elma Elizaba Mathew**, Manoj Balachandran, "Disorders in graphene: Types, Effects and Control Techniques- Review". *Carbon Letters* (2022): 431–450. *https://doi.org/10.1007/s42823-021-00289-4*
3. **Elma Elizaba Mathew,** Manoj Balachandran , "Role of Defects in the Band Gap Tailoring of Carbon Black". *Mapana Journal of Sciences* (2022): Vol 21 No 2. (UGC Care). *doi: 10.12723/mjs.62.0*
4. **Elma Elizaba Mathew,** Manoj Balachandran, "Enhancement of the Electrochemical behaviour of Carbon Black via a defect induced approach" *Emergent Materials* (2024):1-14 . *https://doi.org/10.1007/s42247-024-00686-1*
5. **Elma Elizaba Mathew,** Manoj Balachandran, "Augmentation of the Energy Storage Potential by Harnessing the defects of Charcoal for Supercapacitor Application", *Journal of Energy Storage* (2024): 102 . *https://doi.org/10.1016/j.est.2024.114092*