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Notice for the PhD Viva Voce Examination

Ms Joselyn Elizabeth Abraham, Registration Number: 1981207, PhD Scholar at the Department of Physics and Electronics, School of Sciences, CHRIST (Deemed to be University) will defend her PhD thesis at the public viva-voce examination on Tuesday, 06 January 2026 at 11.00 am in Room No. 044, Ground Floor, R&D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

Title of the Thesis	:	**Tailoring Carbonized Polymer Dots for Multifunctional Applications**
Discipline	:	**Physics**
External Examiner - I	:	**Dr R Thanagavel** Associate Professor Department of Physics Indian Institute of Technology (ISM) Dhanbad, Dhanbad – 826004 Jharkhand
External Examiner - II	:	**Dr M K Rabinal** Professor Department of Physics Karnatak University Dharwad -580003 Karnataka
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: 01 January 2026

ABSTRACT

This thesis examines carbonized polymer dots (CPDs), a sustainable carbon nanostructure with tunable properties. The research explores CPD synthesis for energy storage, sensing, and bioimaging, enabling multiple applications while promoting efficiency. The study examines CPDs in three parts, focusing on dopants, composite design, and precursor modification. In the first section, CPDs were synthesized hydrothermally using o-phenylenediamine at varying temperatures. Temperature affected surface functionality, particle size, and emission behavior. The 200 °C sample showed the highest photoluminescence with 13.74 % quantum yield, and the 240°C sample showed 89 % cell viability. The 220 °C sample achieved a specific capacitance of 58 F g-1 at 1 A g-1. These results depicted the potential of CPD for multifunctional applications. A composite strategy enhanced energy storage using heteroatom-doped CPDs with transition metal dichalcogenides (TMDs) and bamboo-derived porous carbon in the second part. The TMD/CPD electrode showed 142 F g-1 at 1 A g-1 , with 84% capacitance retention after 10000 cycles at 4 A g-1. The porous carbon/CPD hybrid achieved 190 F g-1 at 1 A g-1 and 82% retention after 10,000 cycles at 4 A g-1. A coin cell device with this composite retained 79% performance after 10,000 cycles at 4 A g-1, powering LEDs, a mini fan, and a mini wind turbine. These demonstrated CPD's electrochemical potential in its usage as a conductive additive. In the third section, egg yolk was used during synthesis to introduce multiple dopants into CPDs. The material showed strong solvatochromic behavior, with its use for detecting water content in organic solvents. With detection limits of 0.22% for DMF and 0.19% for ethylene glycol, it displayed its potential as a promising environmental monitoring probe. Also, when doped with boron, CPDs exhibited bright fluorescence, showing 85% cell viability in HEK cells and cytotoxic response in HeLa cells with enhanced photostability, showcasing their ability as a potential biomarker. Henceforth, this work establishes CPDs as multifunctional nanomaterials bridging multiple applications, demonstrating their value in clean energy, environmental monitoring, and biomedical imaging.

Keywords: *Carbonized Polymer Dots, Multifunctional Nanomaterials, Biomass-Derived Carbon, Heteroatom Doping, Supercapacitors, Fluorescence Sensing, Bioimaging, Waste Valorization, Solvatochromism, Sustainability.*

Publications:

1. **Joselyn Elizabeth Abraham**, Manoj Balachandran, "Temperature-Tuned Nitrogen and Oxygen Self- Doped Carbonized Polymer Dots for Enhanced Supercapacitor Applications." Particle & Particle Systems Characterization (2025): https://doi.org/10.1002/ppsc.202400292

2. **Joselyn Elizabeth Abraham**, Manoj Balachandran, "Fluorescent Carbonized Polymer Dots Derived from o-Phenylenediamine and its Photonic Application." Journal of Fluorescence (2024) https://doi.org/10.1007/s10895-024-03652-6

3. **Joselyn Elizabeth Abraham**, Manoj Balachandran, "Fluorescent Mechanism in Zero-Dimensional Carbon Nanomaterials: A Review." Journal of Fluorescence (2022) https://doi.org/10.1007/s10895-022-02915-4

4. **Joselyn Elizabeth Abraham**, Manoj Balachandran, "Synthesis of Emeraldine PANI Polymer- Reduced Graphene and its Use as Polyelectrolyte." Polymer Bulletin (2020) https://doi.org/10.1007/s00289-019-02954-1