Notice for the PhD Viva Voce Examination

Ms A V Ramya (Reg. No. 1445202), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), will defend her PhD thesis at the public viva voce examination on Tuesday, 17 January 2023 at 12.00 pm in the Syndicate Room, (Room No. 802), Ground Floor, Auditorium Block, CHRIST (Deemed to be University), Bengaluru – 560029.

Title of the Thesis	:	**Graphene Quantum Dots: Facile Syntheses, Fruitful Properties and Fascinating Applications**
Discipline	:	**Physics**
External Examiner (Outside Karnataka)	:	**Dr Krishnamoorthi C** Associate Professor Department of Applied Physics Center for Nanotechnology Research Vellore Institute of Technology Vellore - 632014 Tamil Nadu
External Examiner (Within Karnataka)	:	**Dr Habibuddin Shaik** Associate Professor Department of Physics Nitte Meenakshi Institute of Technology Bengaluru - 560064 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.

Registrar

Place: Bengaluru
Date: 10 January 2023

ABSTRACT

Our society is confronted by several global issues, especially in the economic, social, and environmental sectors. Counterfeiting, drug misuse, and water contamination are among the top worldwide concerns escalating at a shocking pace. In this context, this doctoral research focuses on developing and employing advanced materials to find scientific solutions to these problems. To combat forgery, Nitrogen self-doped luminescent carbon dots were developed by simple microwave carbonization of banana peel waste. Different chemical treatments were adapted to modify the as-synthesized dots to enhance their attributes. As a result, all the samples exhibited tunable deep ultraviolet and visible fluorescence. In particular, carbon dots treated by chemical exfoliation were undetectable under daylight and 254 nm irradiation; however, they exhibited bright blue and white hues when exposed to 365 nm and 395 nm excitations, respectively. This property was utilized to develop security ink for multi-mode anti-counterfeiting by photo-switching that provides a high level of affordable protection, perfect for industrial applications.

Graphene quantum dots were produced by one-pot microwave treatment of orange peel waste biomass, and the as-synthesized dots were chemically modified to improve their performance. All the developed samples demonstrated excellent optical attributes, especially tunable fluorescence, high quantum yield, long fluorescence lifetime, and high photostability, suitable for fluorescence sensing applications. The nanostructures were applied to quantify atropine, a drug of abuse, and their analytical performances were investigated and validated in biological fluids and pharmaceuticals. It was observed that hydrothermal-treated graphene quantum dots exhibited remarkable sensing characteristics, including high sensitivity, selectivity, and ultra-low detection limit for quantifying the analyte, displaying their high potential for applications in forensics, toxicology, and drug quality control.

Onion-like carbon nanostructures were synthesized by simple flame pyrolysis of paraffin oil. The as-synthesized nanostructures were further refashioned by different chemical treatments to improve their features. As a result, each sample demonstrated superior chemical and textural properties, such as oxygen-rich surface, high specific surface area, and plenty of mesopores, ideal for adsorption of small organic molecules. The adsorptive behavior of the nanostructures was evaluated by studying their adsorption pattern and kinetics for the removal of the textile dye contaminant methylene blue from wastewater. It was observed that the onion-like carbon nanostructures treated by acidic oxidation displayed remarkable adsorption efficiency of 1397.35 mg/g, whereas those treated by chemical exfoliation exhibited rapid adsorption kinetics, completely removing the dye pollutant within 10 minutes. This study implies that these nanostructures could be utilized to remove methylene blue rapidly and effectively from industrial wastewater.

Keywords: carbon dots, graphene quantum dots, onion-like carbon, anti-counterfeiting, fluorescence detection, wastewater remediation

Journal Publications

1. **Ramya, A. V.,** Riya, T., & Manoj, B. (2021) Mesoporous onion-like carbon nanostructures from natural oil for high-performance supercapacitor and electrochemical sensing applications: Insights into the post-synthesis sonochemical treatment on the electrochemical performance. *Ultrasonics Sonochemistry,* 79 p.105767. https://doi.org/10.1016/j.ultsonch.2021.105767
(Impact factor – 9.336)

2. **Ramya, A. V.** & Manoj, B. (2021) Valorization of agro-industrial fruit peel waste to fluorescent nanocarbon sensor: Ultrasensitive detection of potentially hazardous tropane alkaloid. *Front. Environ. Sci. Eng*. 16(3) 1-11. https://doi.org/10.1007/s11783-021-1461-z
(Impact factor – 6.048)

3. **Ramya, A. V.** & Manoj, B. (2020). Novel carbon nano-onions from paraffinum liquidum for rapid and efficient removal of industrial dye from wastewater. *Environ Sci Pollut Res*, 27(35) 43845–43864. https://doi.org/10.1007/s11356-020-09981-w
(Impact factor – 5.190)

4. **Ramya, A. V.**, Neethu, J., & Manoj, B. (2021). Facile Synthesis of Few-Layer Graphene Oxide from Cinnamomum Camphoria. *Nanobiotechnology Reports,* 16(2) 183-187.
(SJR – 0.214)

5. **Ramya, A. V.,** & Manoj, B. (2018). Transformation of hydrocarbon soot to graphenic carbon nanostructures. *Biointerface Res. Appl. Chem*, *8*(3) 3187-3192.
(SJR – 0.247)

6. **Ramya, A. V.**, Mohan, A. N., & Manoj, B. (2016). Wrinkled graphene: Synthesis and characterization of few layer graphene-like nanocarbons from kerosene. *Materials Science-Poland, 34*(2) 330-336. https://doi.org/10.1515/msp-2016-0061
(Impact factor – 0.889)

7. Mohan, A. N., Manoj, B., & **Ramya, A. V.** (2016). Probing the nature of defects of graphene like nanocarbon from amorphous materials by Raman spectroscopy. *Asian Journal of Chemistry, 28*(7) 1501. https://doi.org/10.14233/ajchem.2016.19739 (SJR – 0.16)

8. Mohan, A. N., **Ramya, A. V.**, & Manoj, B. (2016). Synthesis and characterization of sp^2-sp^3 bonded disordered graphene like nanocarbon from coconut shell. Advanced Science, Engineering and Medicine, 8(2) 112-116.
https://doi.org/10.1166/asem.2016.1840

9. **Ramya, A. V.**, B. Manoj, & Mohan, A. N. (2016). Extraction and characterization of wrinkled graphene nanolayers from commercial graphite. *Asian Journal of Chemistry, 28*(5) 1031. http://dx.doi.org/10.14233/ajchem.2016.19577
(SJR – 0.16)