ECMC-P 2025 Conference

The 1st International Electronic Conference on Medicinal Chemistry and Pharmaceutics

01–30 November 2025 | Online

MDPI

Fluorescent Carbon Dots: Emerging Multifunctional Platforms for Drugs Delivery and Bioimaging

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INTRODUCTION & AIM

Carbon Dots (CDs) have attracted growing attention as innovative nanomaterials with remarkable physicochemical and optical properties. Their tunable fluorescence, excellent biocompatibility, and ease of surface functionalization make them highly versatile for biomedical use. Recent studies highlight their dual potential as drug delivery nanocarriers and fluorescent probes for bioimaging, opening new perspectives in diagnosis and targeted therapy.

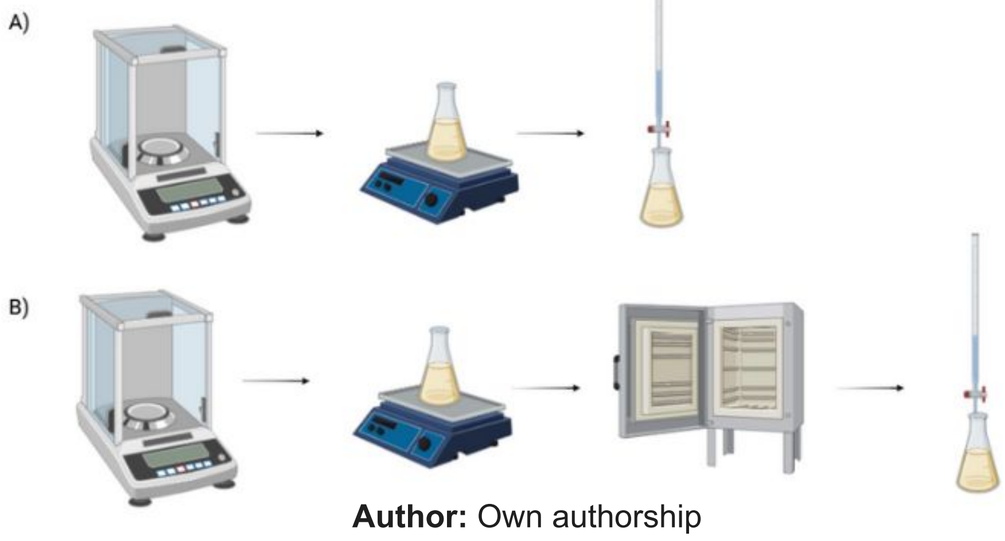
Given this multifunctional nature, a thorough understanding of their structural and optical characteristics is essential to optimize performance and ensure safety in pharmaceutical and diagnostic applications.

This study aims to characterize the physicochemical and fluorescence properties of Carbon Dots, correlating their structural features with potential biomedical applications, particularly in drug delivery and bioimaging.

METHOD

Carbon Dot Synthesis

Illustration 1. (A) Synthetic route by oil bath at 200°C for 30 min; **(B)** Hydrothermal method, using the muffle furnace at T = 200°C for 4 h.



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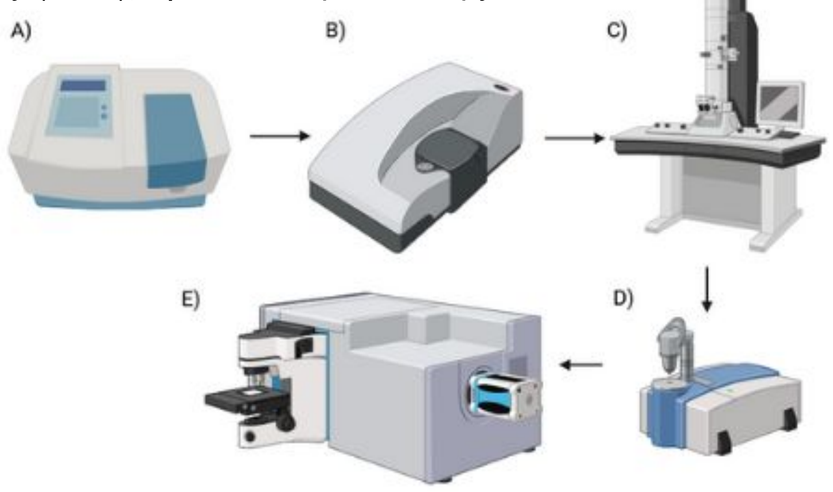
Characterization

Ilustration 2. A) UV-Vis Absorption Spectroscopy; **B)** Zeta Potential; **C)** Transmission Electron Microscopy (TEM); **D)** Fourier Transform Infrared Spectroscopy (FTIR); **E)** Raman Spectroscopy



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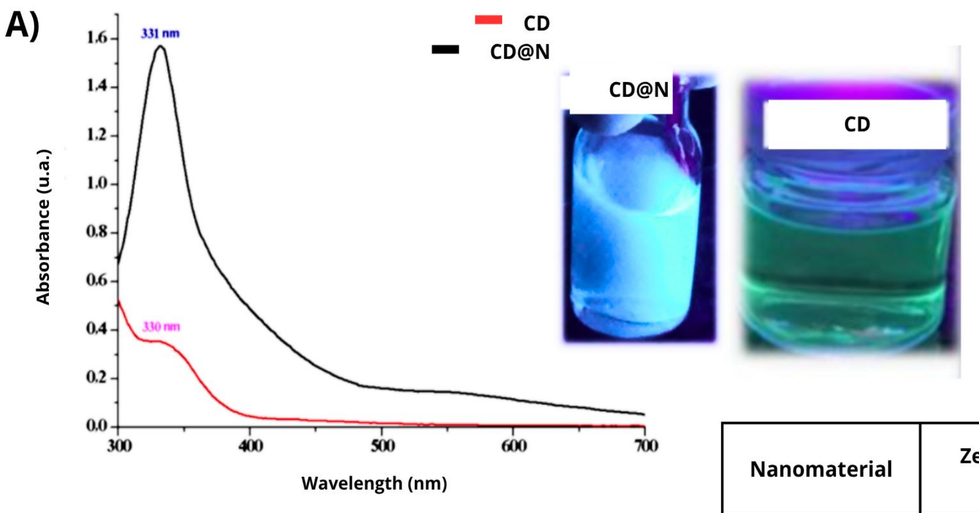
RESULTS & DISCUSSION

Figure 1. Absorption spectroscopy of nitrogen-doped CD and CD (CD@N), along with their zeta potential



Nanomaterial	Zeta Potential (ζ/mV)
CD	-18,7
CD@N	-28

Figure 2. ATR-FTIR spectrum configuring the vibrational bands of CD@N

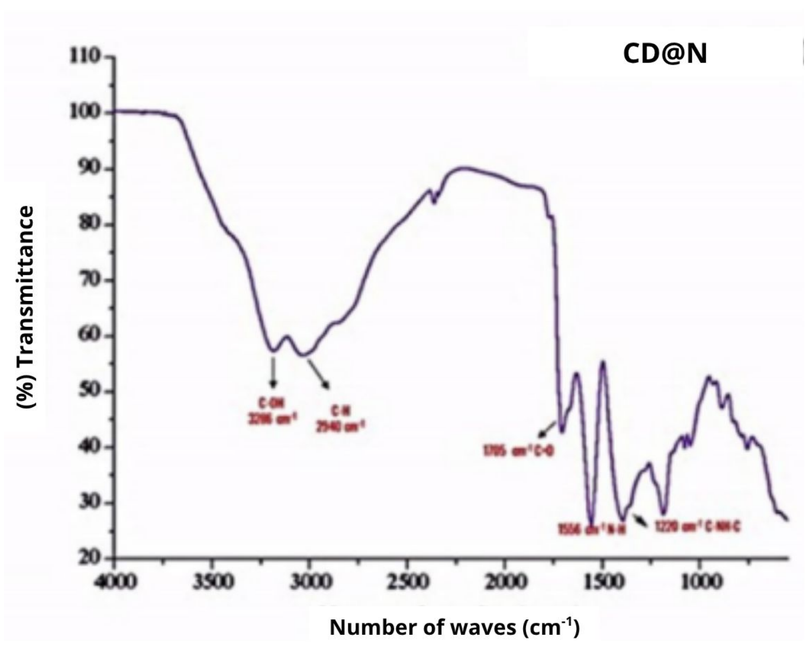
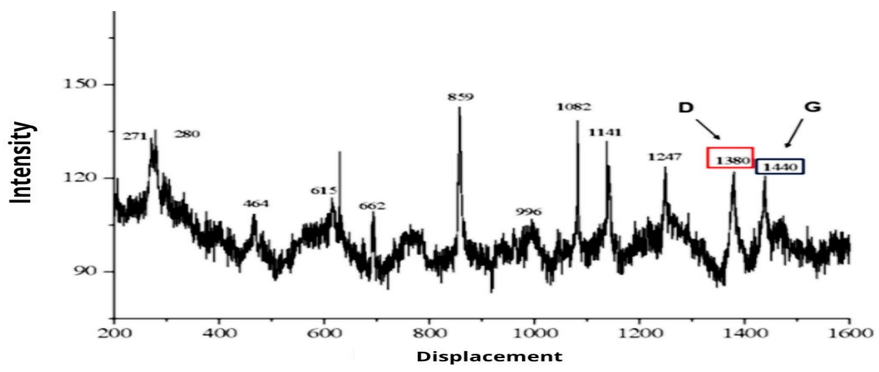


Figure 3. Raman spectroscopy highlighting the D and G bands characteristic of carbonaceous materials.



CONCLUSION

The combination of small size (<10 nm), high photostability, tunable fluorescence, and negative surface charge highlights the multifunctional potential of CDs. These features support their application both as drug delivery systems, responsive to physiological conditions, and as fluorescent probes for bioimaging, reinforcing their relevance as advanced platforms in therapeutic and diagnostic contexts.

FUTURE WORK / REFERENCES

The synthesized Carbon Dots are intended for future testing as contrast agents and drug delivery nanocarriers in solid and liquid oncological models, aiming to expand their theranostic applications.