Luminous Odyssey: NGQDs Light the Way for Alzheimer's Drug Delivery

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Abstract

Graphene quantum dots (GQDs) represent the forefront of contemporary research within the domain of biophysics. Known for their innumerable applications, these nanoparticles have remarkable functionalities in cellular imaging and drug delivery applications. In our research, we combine NGQDs (Nitrogen-doped GQDs) with the ligand L2 to create a drug delivery system for L2, an anti-Alzheimer's drug. L2 faces challenges in traversing the blood-brain barrier (BBB) due to its inherent properties. However, the BBB is permeable to NGQDs due to their small size. Hence, we are using NGQDs as a vehicle to facilitate the transport of L2 across the BBB. Furthermore, the intrinsic fluorescence of NGQDs within the body enables us to safely monitor and track the hybrid system, ensuring its successful delivery to the targeted organ – the brain.

Introduction

Graphene Quantum Dots (GQDs)

- Water soluble
- Nano-sized
- Can be used for:
  - Drug delivery
  - Cell imaging
  - Gene targeting

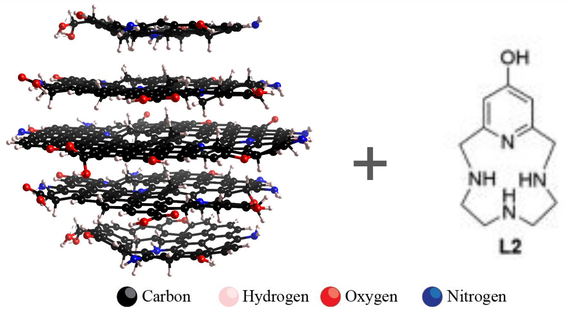
GQDs and Their Importance in Drug Delivery

- Imaging and detection - Optoelectronic properties and NIR fluorescence
- Biocompatibility and biodegradability
- Drug delivery vehicle - GQD's can form complexes with biomaterials.

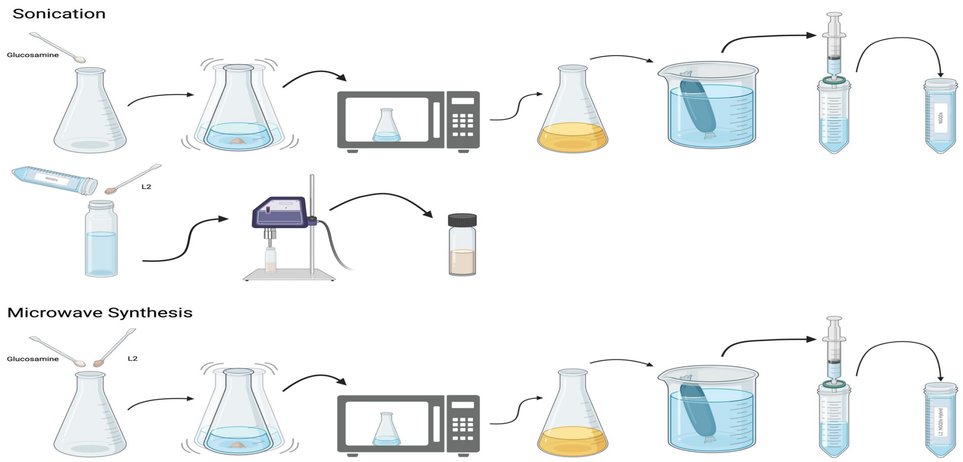
The Current Scenario:

- L2 ligand - anti-alzheimer's drug unable to cross the blood-brain barrier
- Nitrogen-doped GQDs (NGQDs) are permeable through the blood-brain barrier.
- We create a hybrid of L2 and NGQDs to deliver the drug across the blood-brain barrier.

Molecular Structures

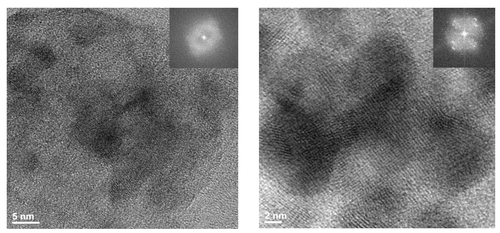


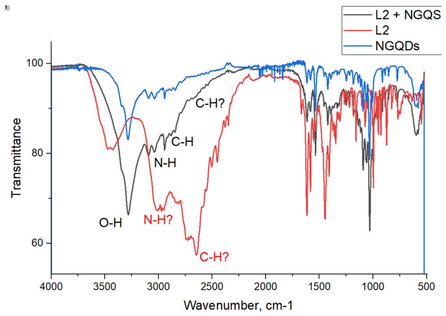
Methods



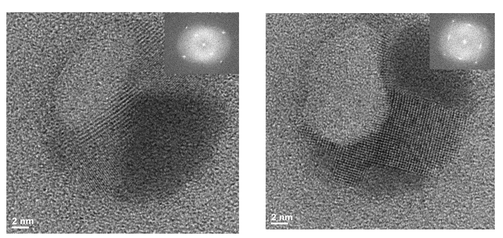
L2 Functionalization

Synthesized Hybrid



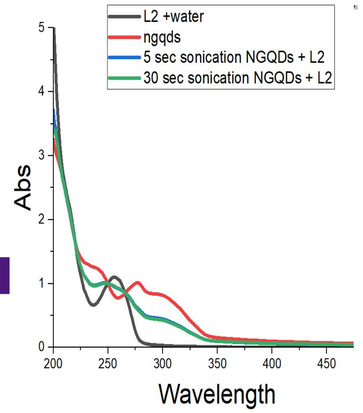


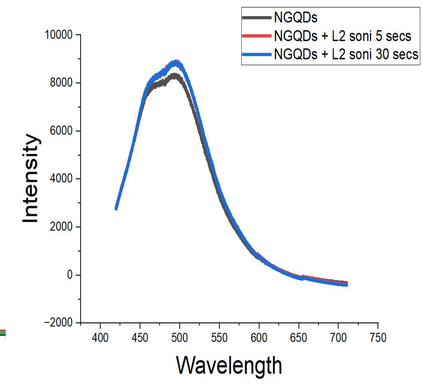
Sonicated Hybrid



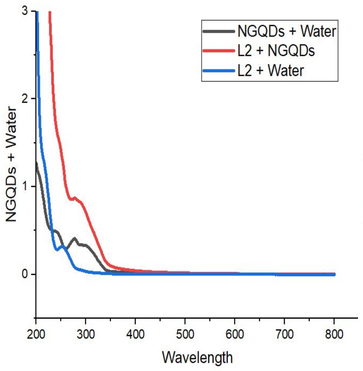
Comparison

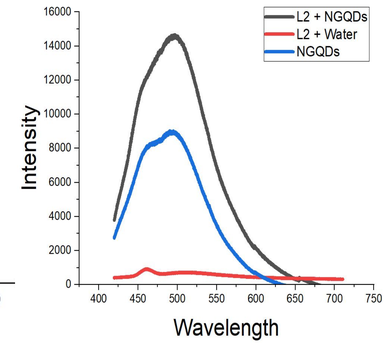
Sonicated Hybrid





Synthesized Hybrid





Conclusion

- L2 complexation with NGQDs - possibility of binding, with NGQDs as the drug-carrier.
- If L2 complexation with NGQDs is:
  - safe in human body
  - able to cross blood-brain barrier
    - Then, NGQDs will successfully prove to be a drug vehicle for L2, allowing us to treat Alzheimer's more effectively.

References

Dalton Trans., 2019,48,12430

Our study is exploring a new way to deliver medicine to the brain to treat Alzheimer's disease. We're using tiny particles called quantum dots, which can easily enter the brain. We're combining these particles with an Alzheimer’s drug, L2, which normally struggles to reach the brain on its own. By teaming up quantum dots with L2, we hope to create a delivery system that can effectively transport the drug to the brain. If our tests show that this approach works well and is safe for people, it could significantly improve the treatment of Alzheimer's disease.