
TCU

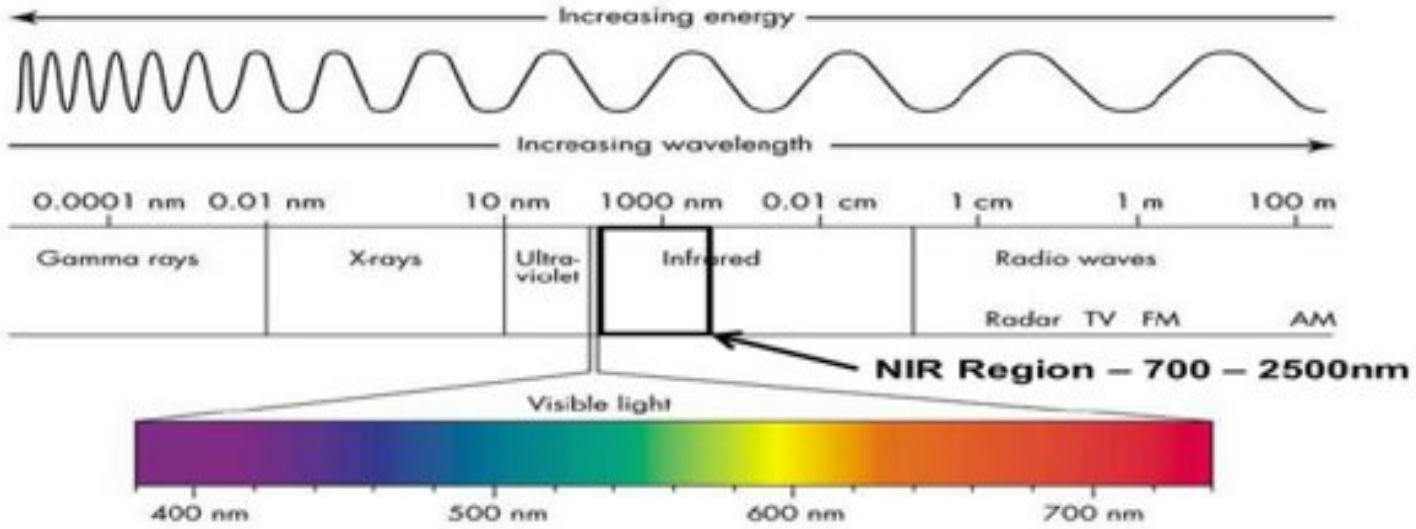
Development of Biocompatible Graphene Quantum dots with Near-Infrared Fluorescence

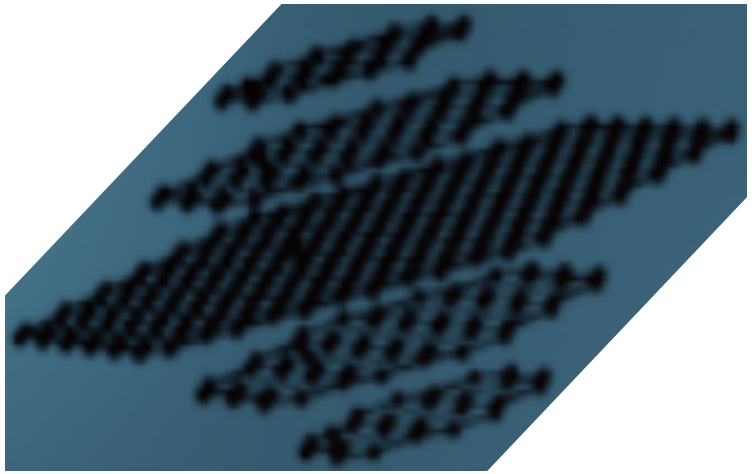
MARANATA DADET, ANTON V. NAUMOV, BONG HAN LEE

DEPARTMENT OF PHYSICS AND ASTRONOMY

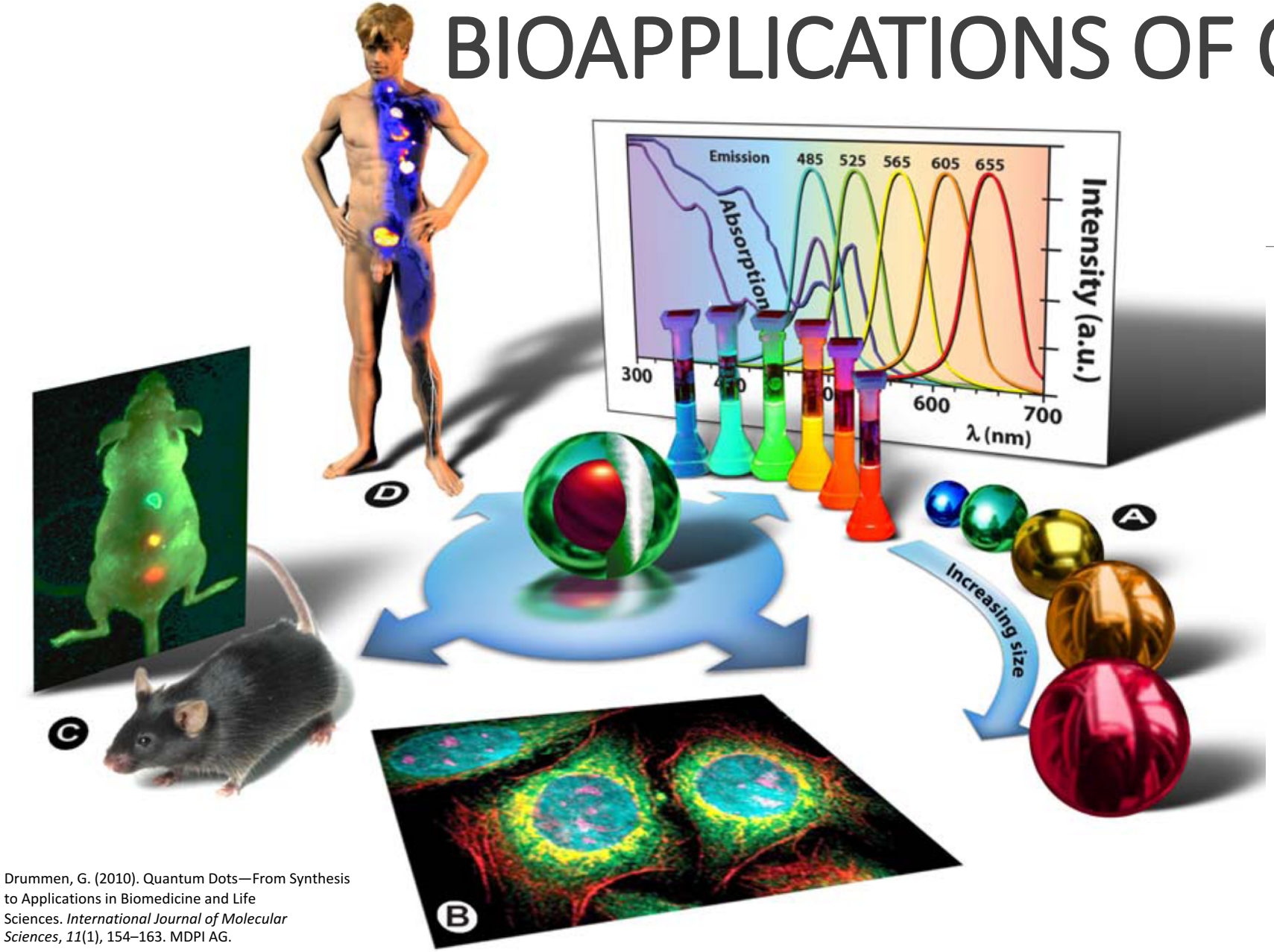
OBJECTIVE

- Develop more quantum dots that can emit in the near infrared region





BIOAPPLICATIONS OF QUANTUM DOTS



- Dug carrying agents
- Imaging agents
- Small size
- Fluorescence
- Benign

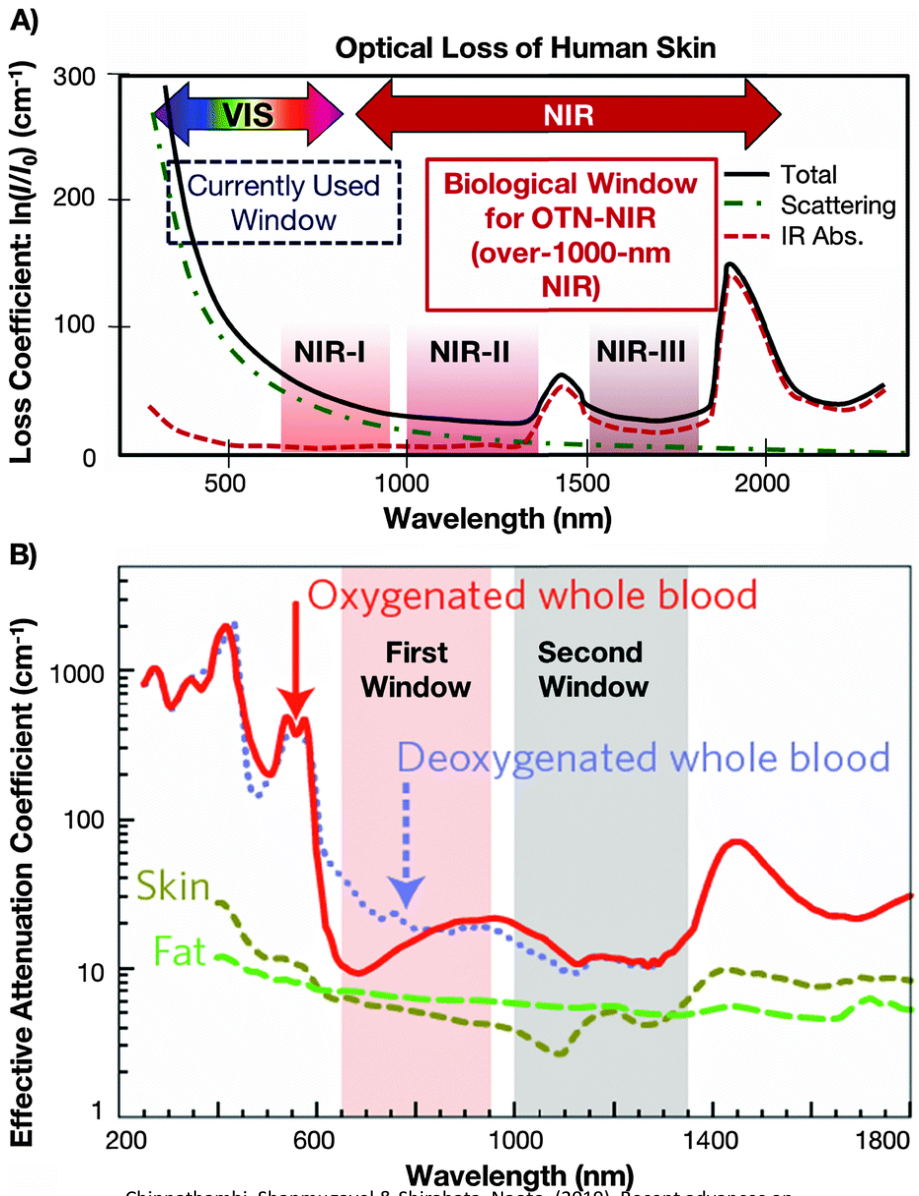
Drummen, G. (2010). Quantum Dots—From Synthesis to Applications in Biomedicine and Life Sciences. *International Journal of Molecular Sciences*, *11*(1), 154–163. MDPI AG.

GRAPHENE QUANTUM DOTS WITH NIR FLUORESCENECE

- Developed more Graphene GQDs
- Used Top-down and Bottom-up approaches

Bottom-Up Synthesis:
- Glucose and Liquid Ammonia
- L-Glutamic acid

Top-Down Synthesis:
- Reduced Graphene Oxide



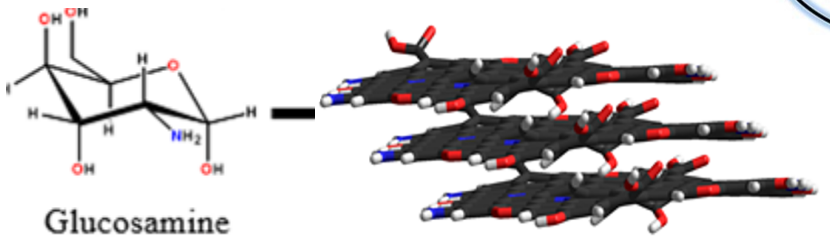
Chinnathambi, Shanmugavel & Shirahata, Naoto. (2019). Recent advances on fluorescent biomarkers of near-infrared quantum dots for in vitro and in vivo imaging. Science and Technology of Advanced Materials.

Top-Down Synthesis

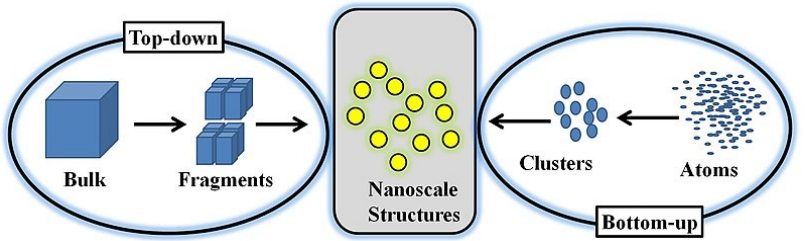
- The building blocks of a bulk material are separated to form the nanomaterial
- Involves scission of the larger material with physical or chemical means

Bottom-Up synthesis

- Atoms assemble and form clusters to make the nanomaterial

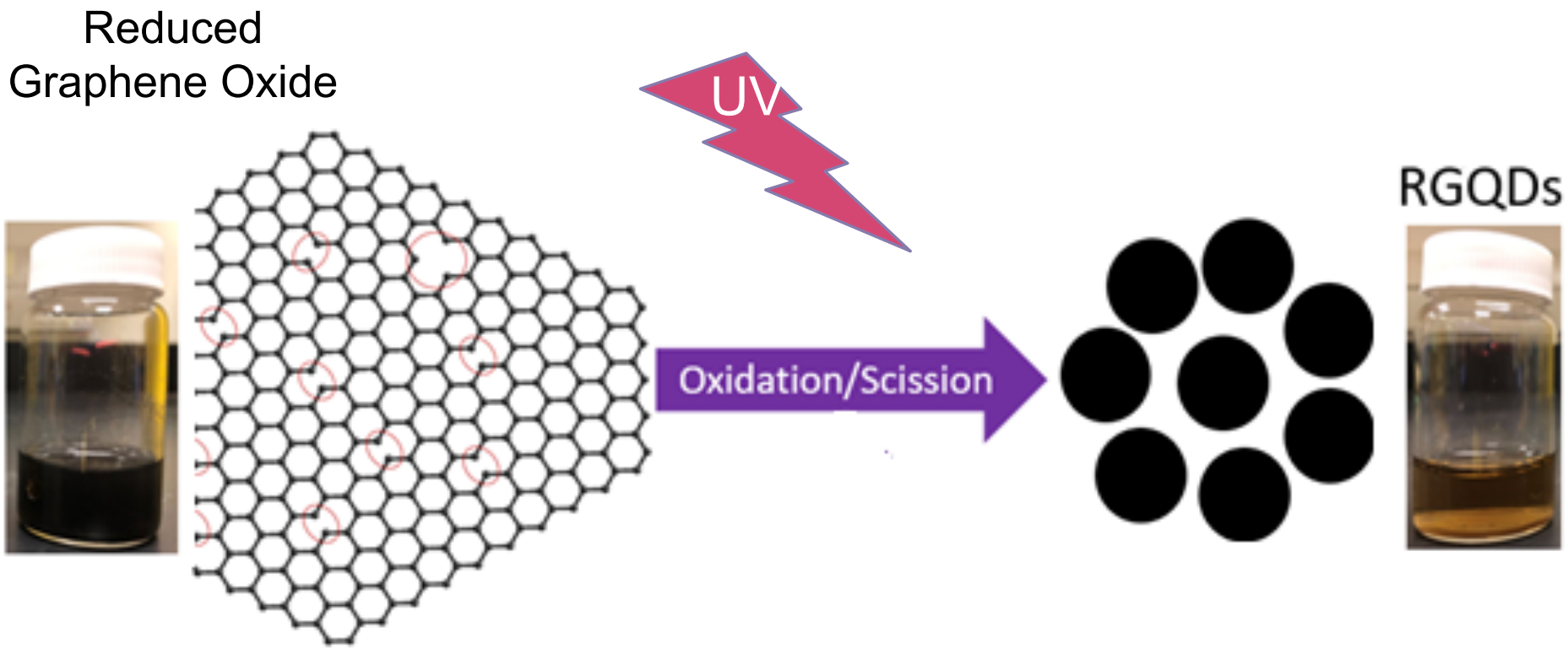


Glucosamine



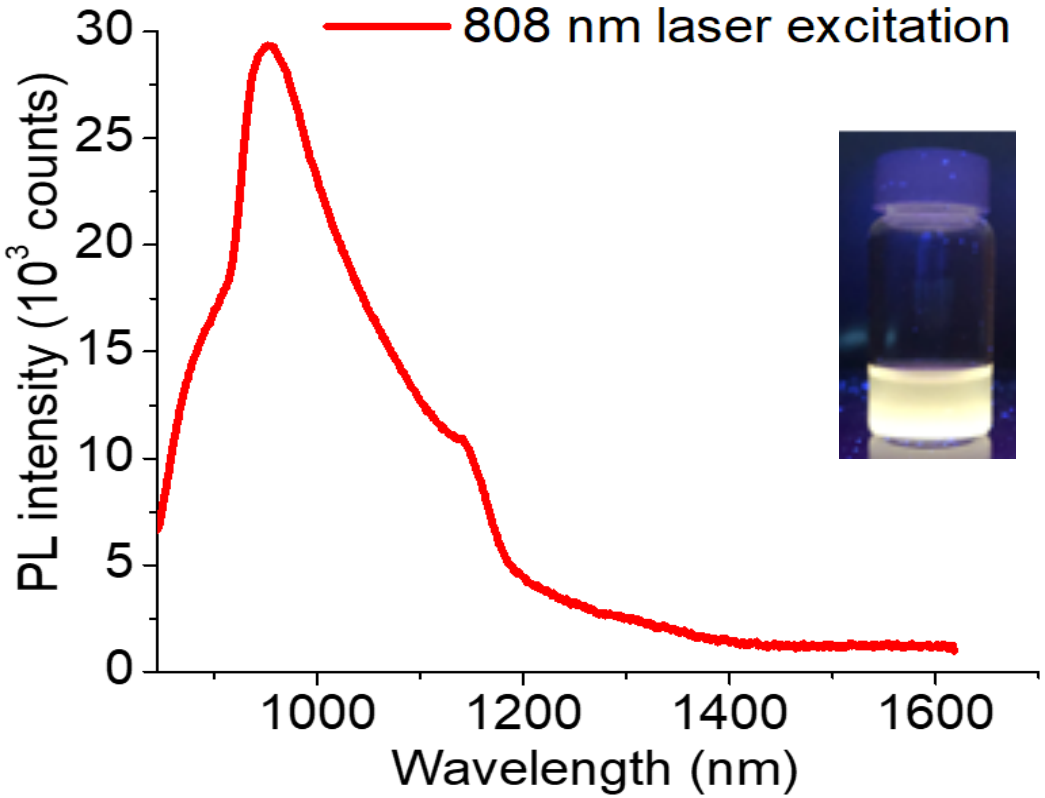
Habiba, Khaled & Makarov, Vladimir & Weiner, Brad & Morell, Gerardo. (2014). Fabrication of Nanomaterials by Pulsed Laser Synthesis. 10.13140/RG.2.2.16446.28483.

Top down – reduced graphene oxide-based quantum dots (RGQDs)

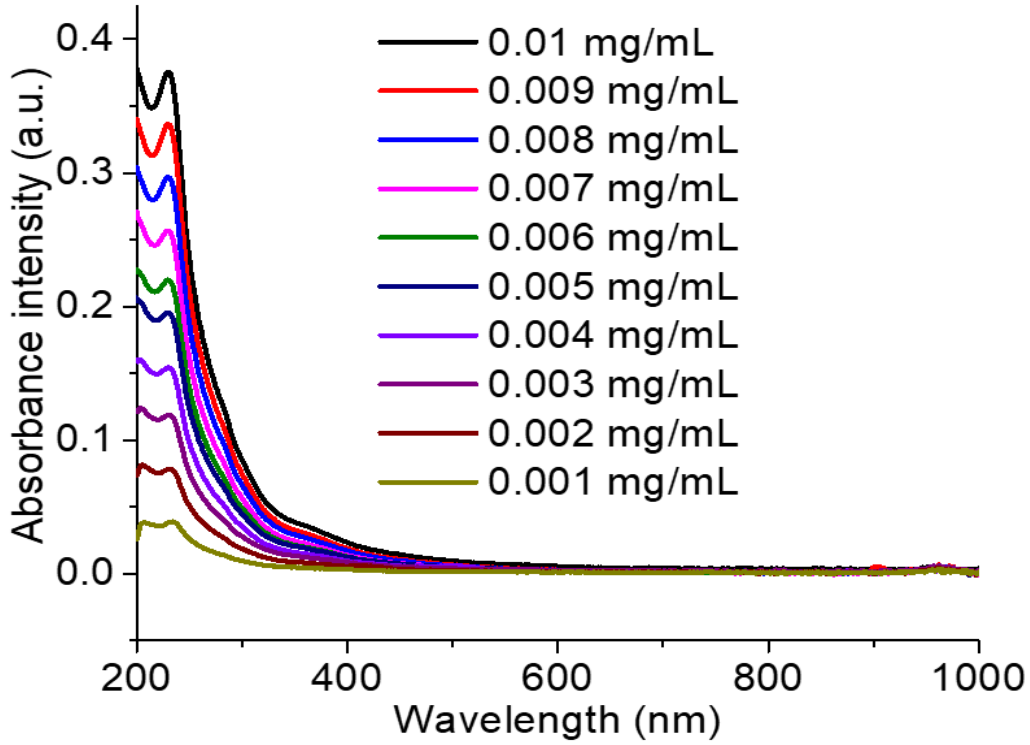


Optical Properties- RGQDs

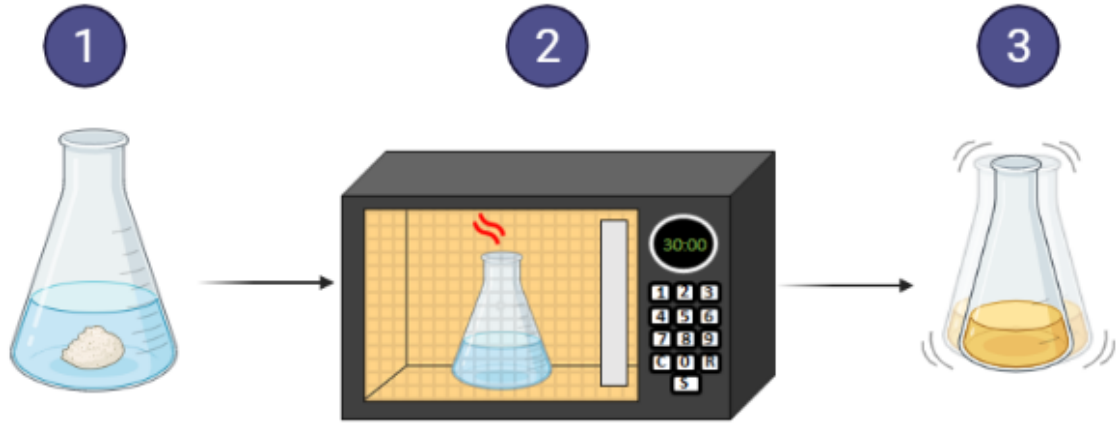
Fluorescence spectrum



Absorbance spectra



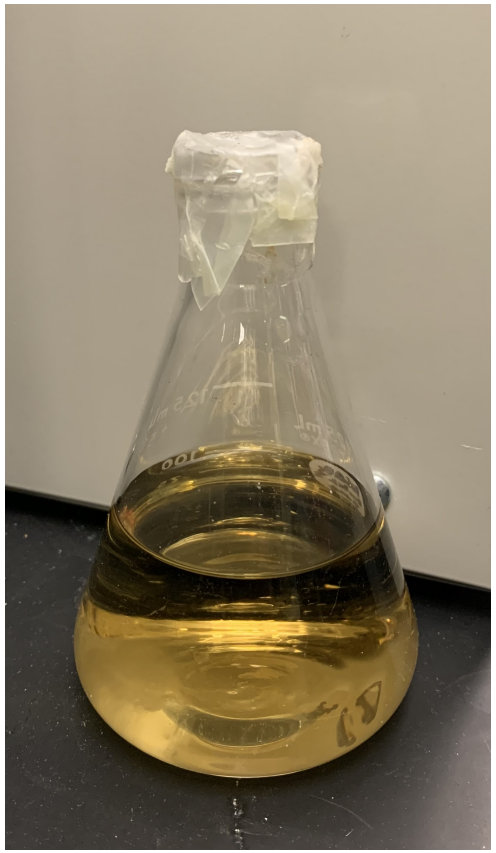
Bottom-Up
Glucose and NH3OH-Based GQDs



Mixture of the precursors with water

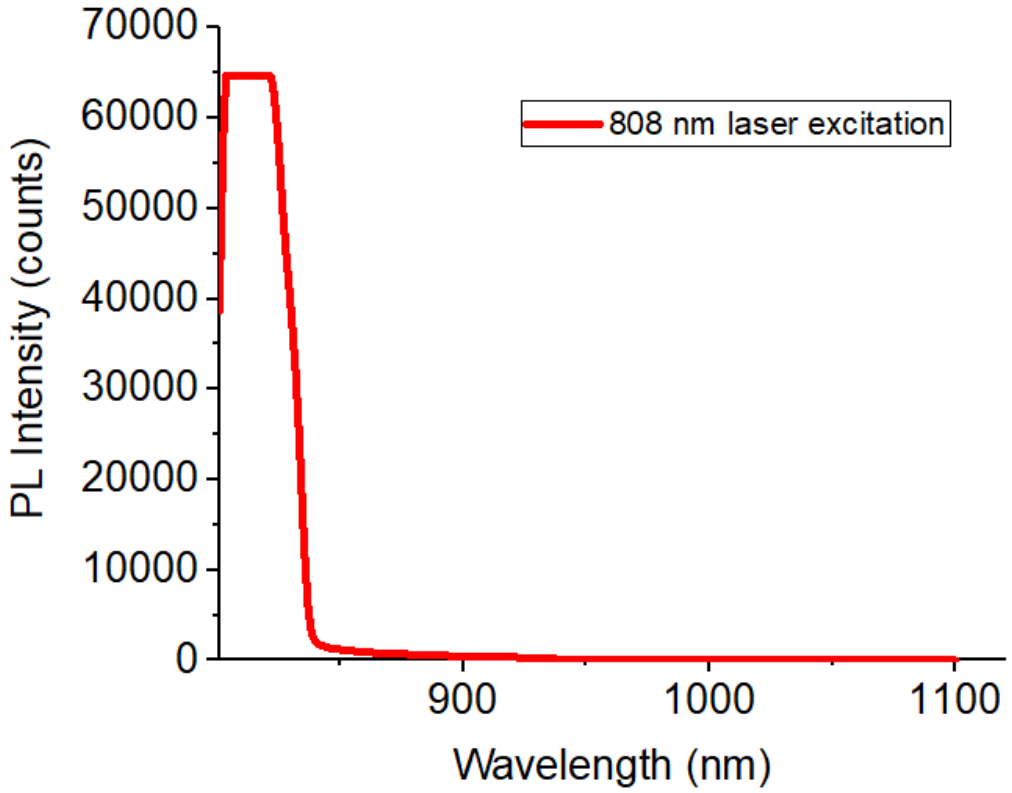
Microwave synthesis

Resulting Solution

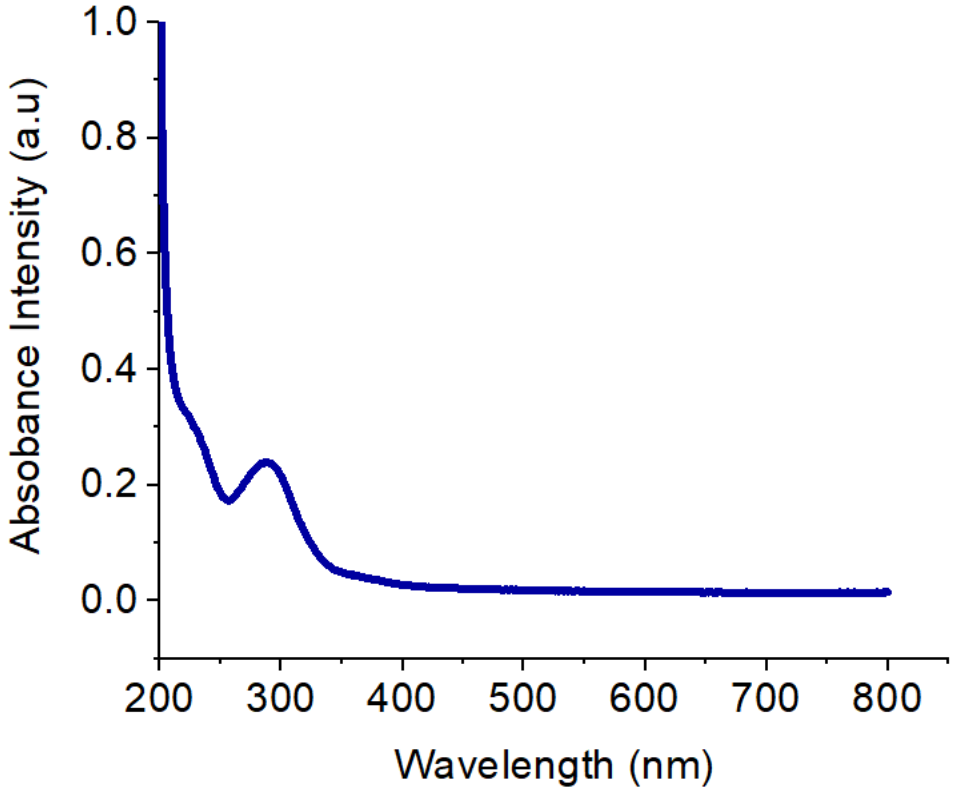


Optical Properties- Glucose + GQDs

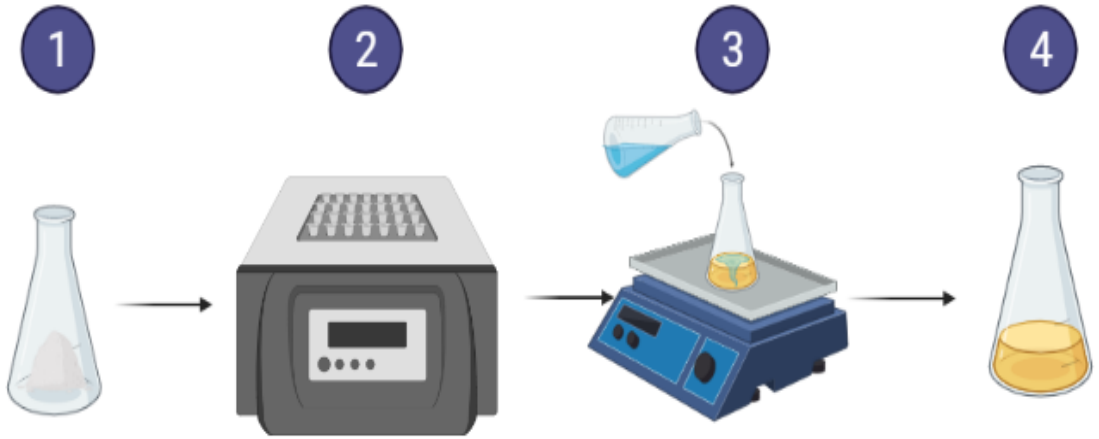
Fluoresence spectrum



Absorbance spectrum



Bottom-Up Synthesis – L- Glutamic Acid-Based GQDs

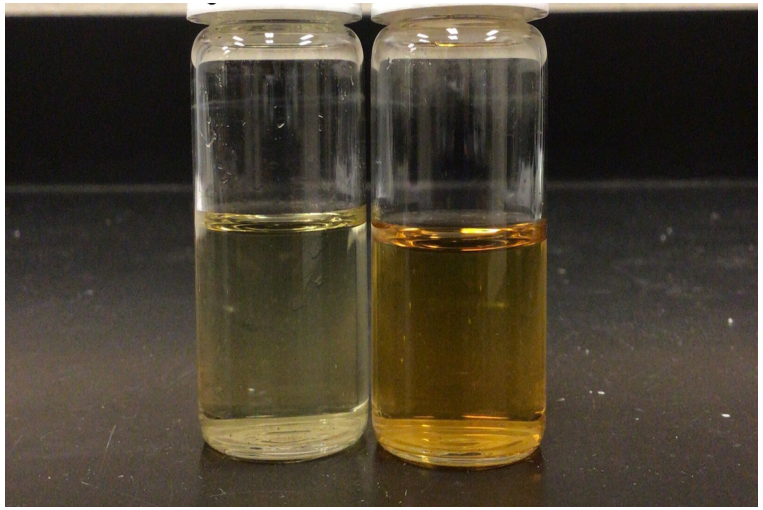


Sample of L-Glutamic Acid

Melted using oven

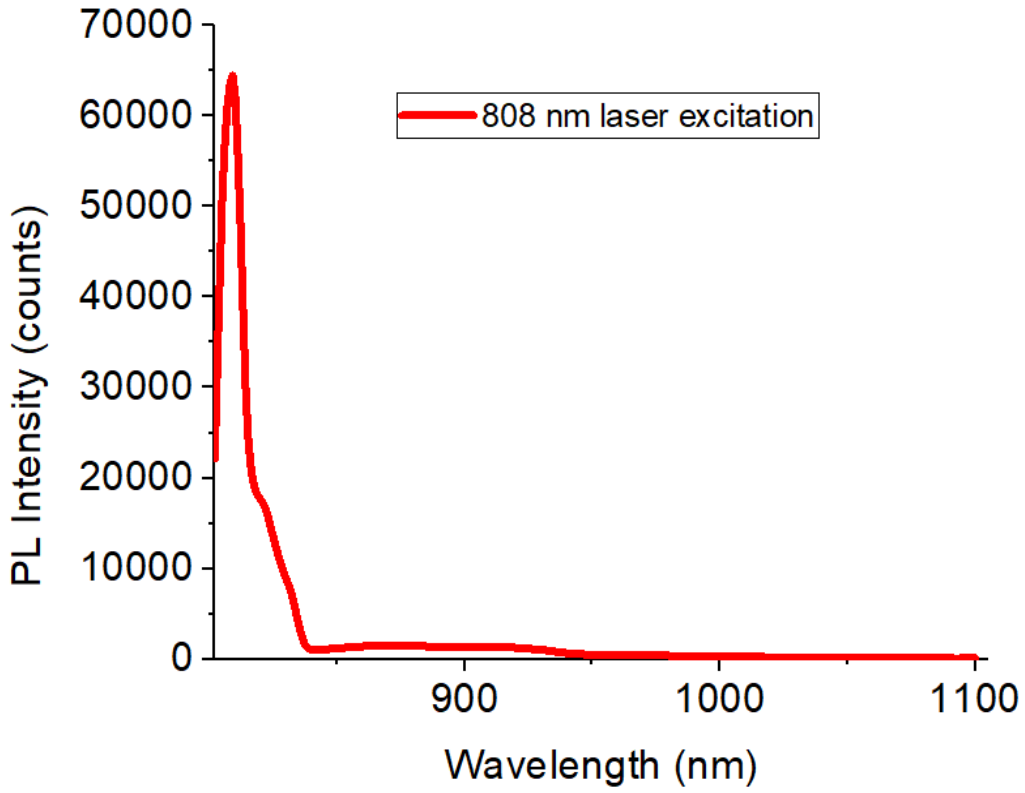
Mixture of the melted precursor with water is stirred

Resulting Solution

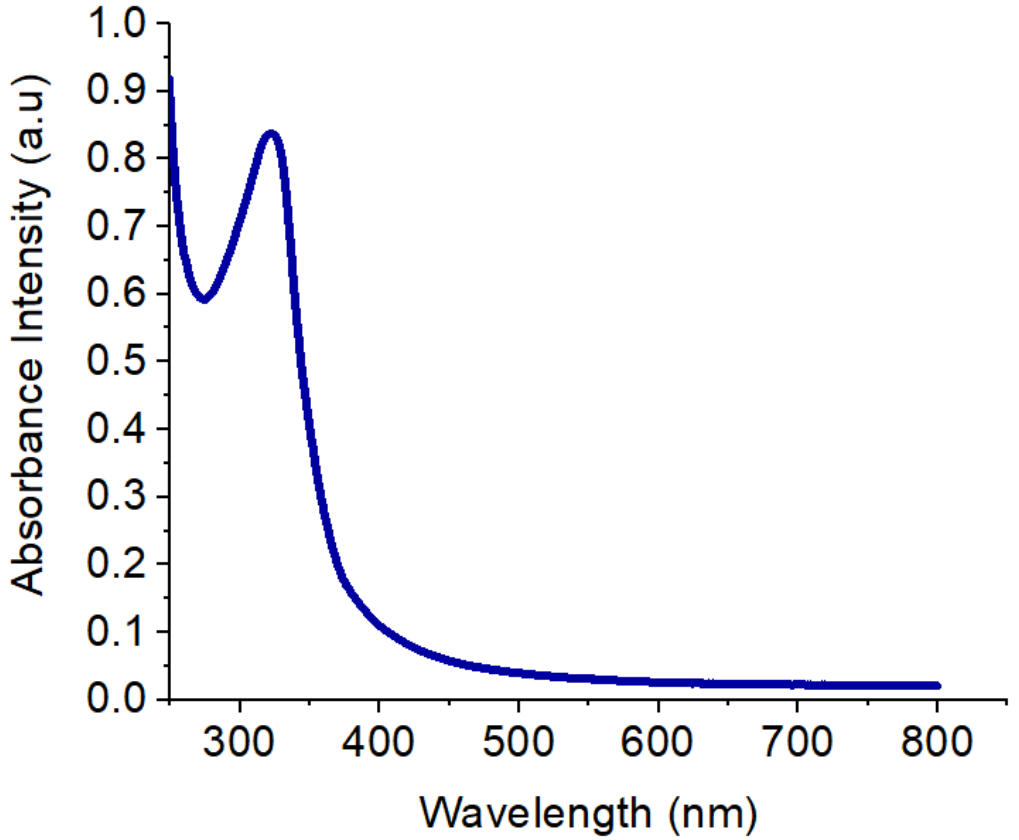


Optical Properties- L-Glutamic Acid-Based GQDs

Fluoresence spectrum



Absorbance spectrum

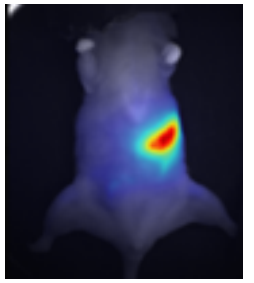


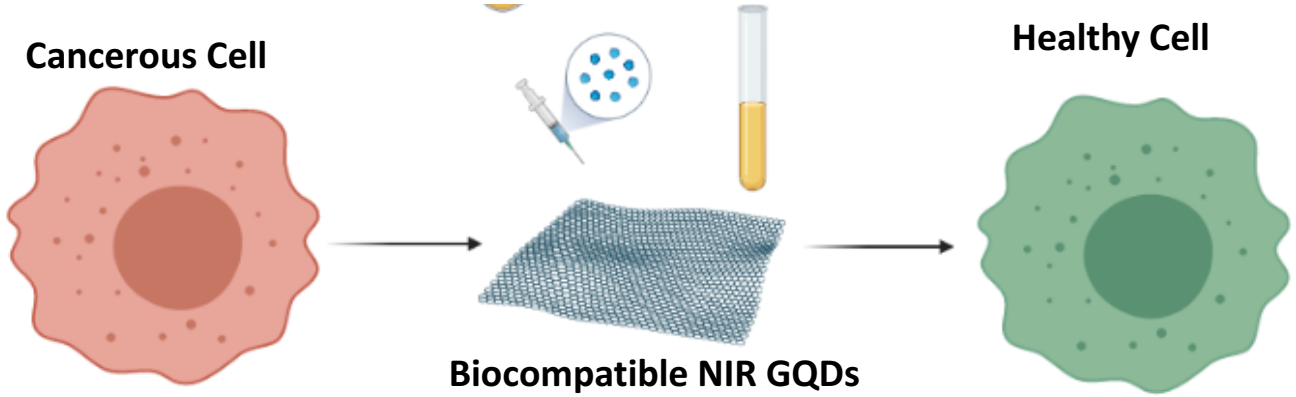
1 Summary

- While multiple synthetic procedures attempted, 3 types of synthesized GQDs appeared to have beneficial near-infrared fluorescence.
- There are few to none such structures with near-infrared emission developed in the World

2 Future applications

- Cell Imaging
- Animal/Human (low depth) imaging
- Optoelectronic devices
- pH-based cancer sensors:





3 Trials and Errors

- Urea Citric +Acid + Hydrogen peroxide
- Folic Acid
- Aniline

4 Conclusion

Graphene Quantum Dots that are harmless nanoparticles that can emit light in the infrared region (750-2500nm). Due to those two properties, they are good to be used to detect and deliver drugs to cancerous cells. They can image which part of the body might have tumors and make it easy for doctors to target and remove them. They can also be used to deliver drugs to the body without having to go through chemotherapy. They could be mini doctors. GQDs have the potential to be the reality we have seen from Sci-Fi movies.

Given that there currently are only few kinds GQDs known to emit light in the Near Infrared region, our lab sought to find whether more kinds of GQDs could be made and have found three. This amazing achievement brings us closer to find better ways to detect and cure cancer and save lives. It means that soon, no one will have to lose a loved one due to cancer.

ACKNOWLEDGEMENTS

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