Near-Infrared Fluorescence Imaging in Mice with Graphene Quantum Dots

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Introduction

-Nanomaterials have been used as drug/gene delivery vehicles as well as imaging probes in biological systems

-Near-infrared (NIR) imaging with nanomaterials is desirable due to low biological autofluorescence, low tissue scattering, and increased penetration depth in animal tissue.

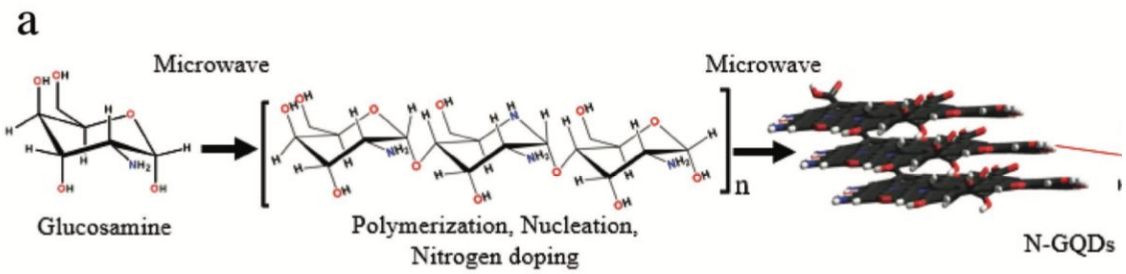
-Poor biocompatibility, complex preparation methods, and cost prevent certain current imaging platforms for clinical use

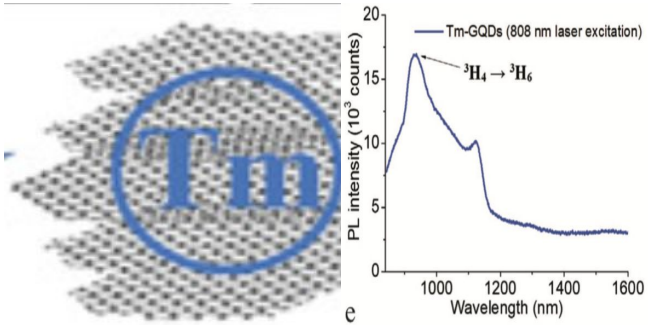
Graphene Quantum Dots: A Possible Solution

-To rectify this issue, we developed graphene quantum dots (GQDs) synthesized from a microwave-assisted bottom-up approach using glucosamine as a precursor

-In order to obtain near-IR (NIR) emission, we dope the GQDs with Tm^{3+} ions, which contain intrinsic atomic transitions in the NIR region

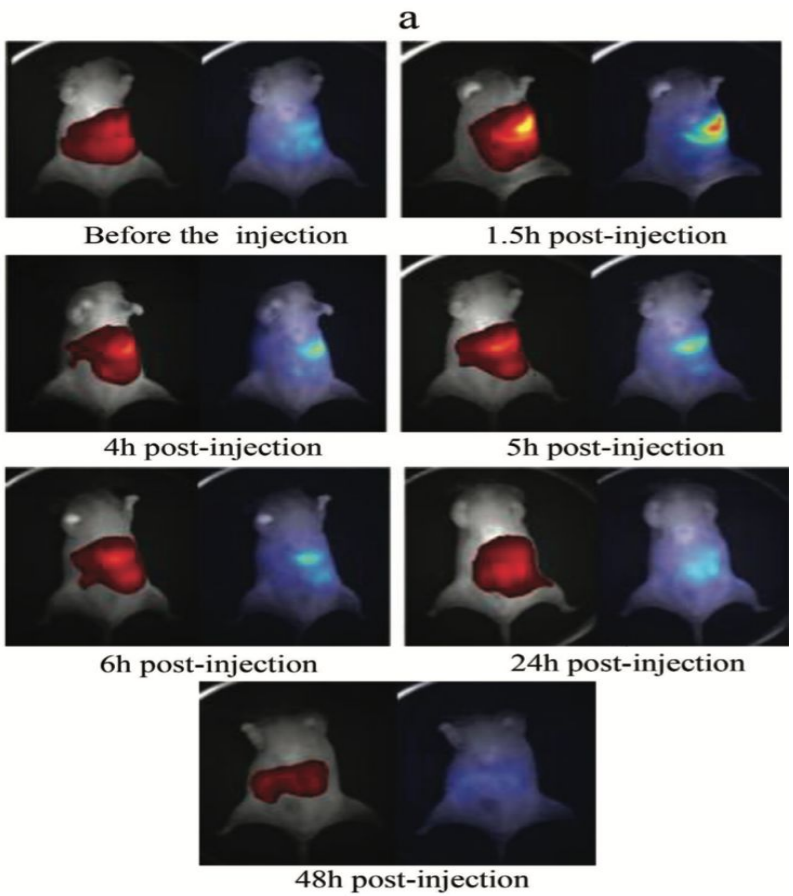
-These GQDs show high biocompatibility as well

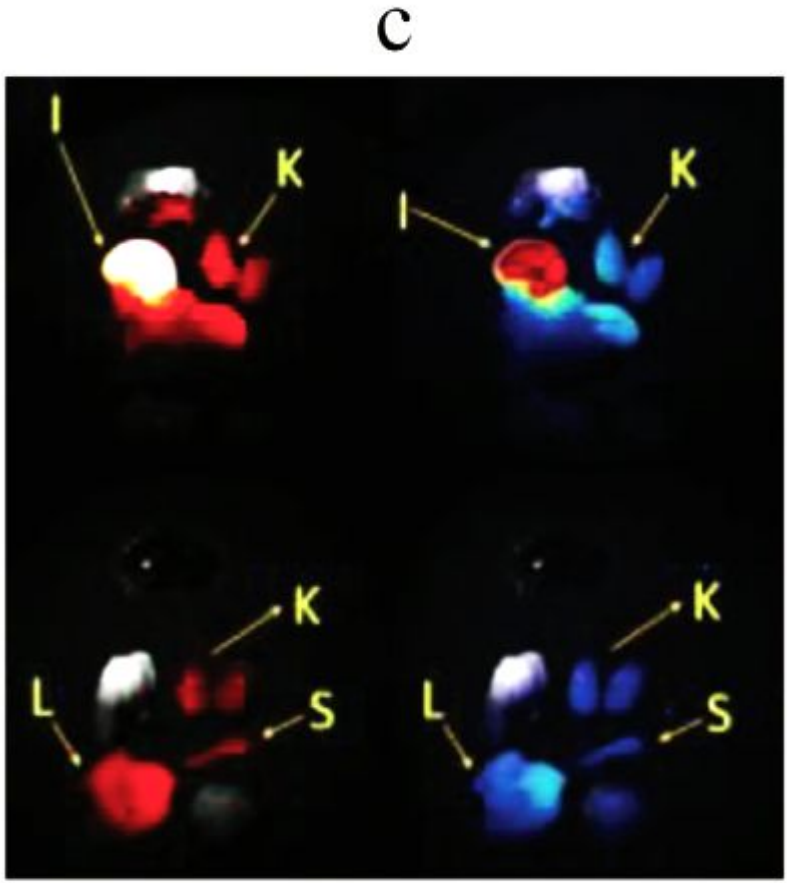




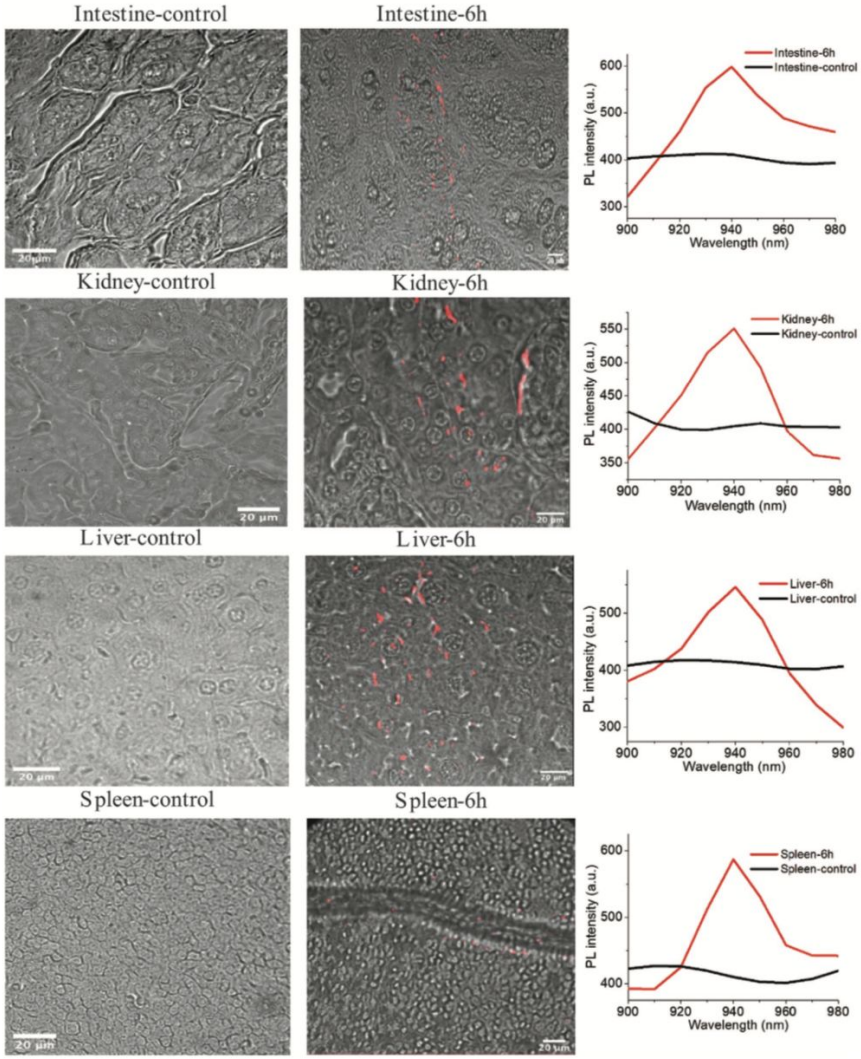
Hasan, et al. *Advanced Functional Materials* (2018).

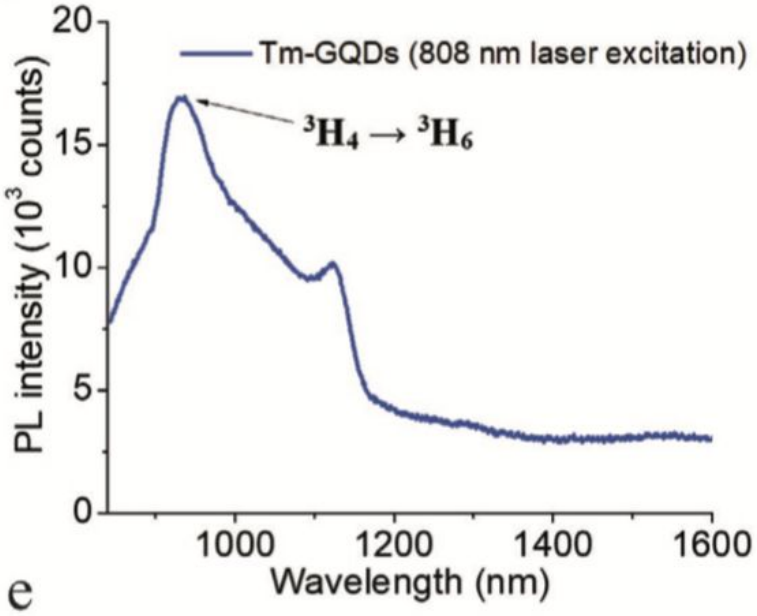
Animal Imaging





Hasan, et al. *Advanced Optical Materials* (2020).





Hasan, et al. *Advanced Optical Materials* (2020).

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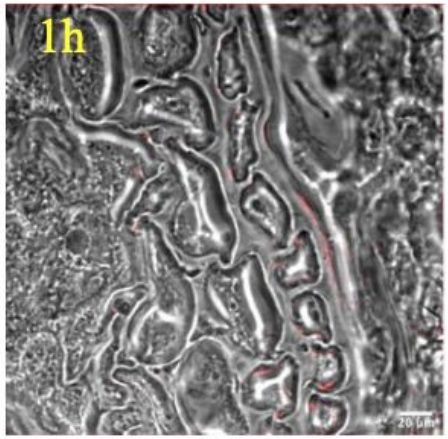
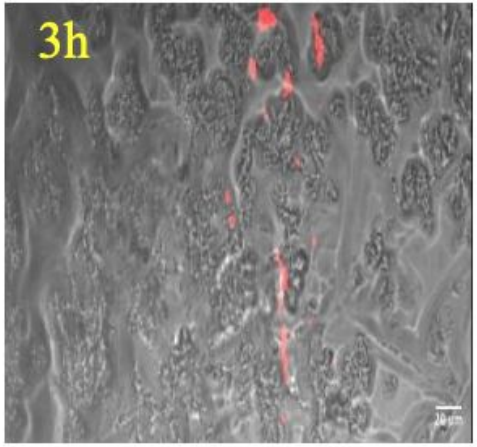
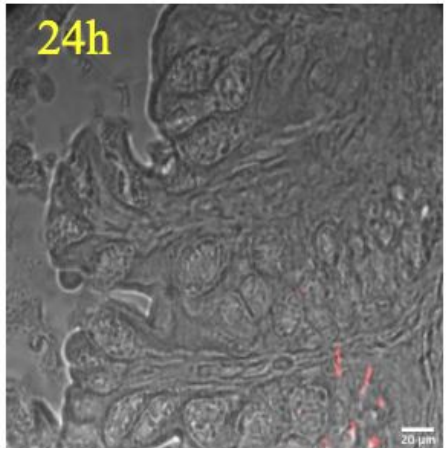
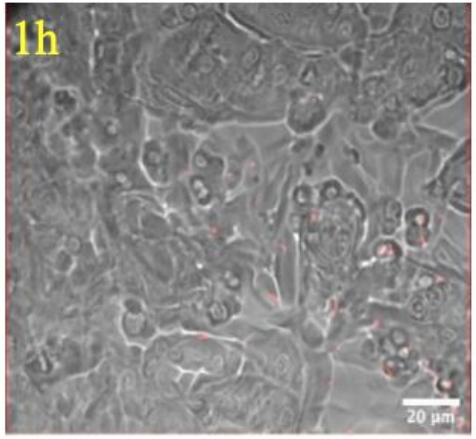
Intestine

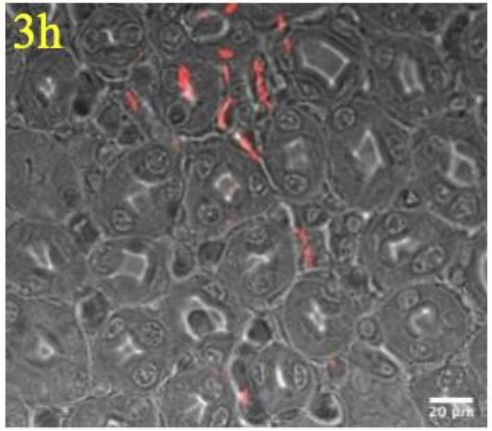


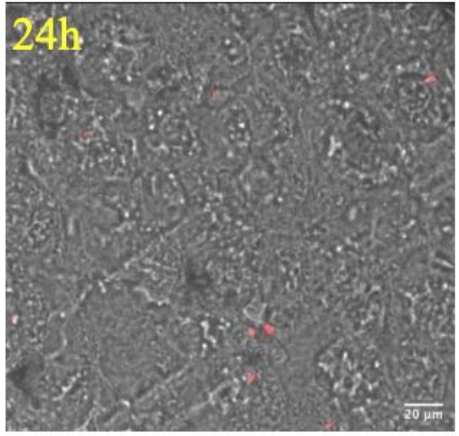




Liver







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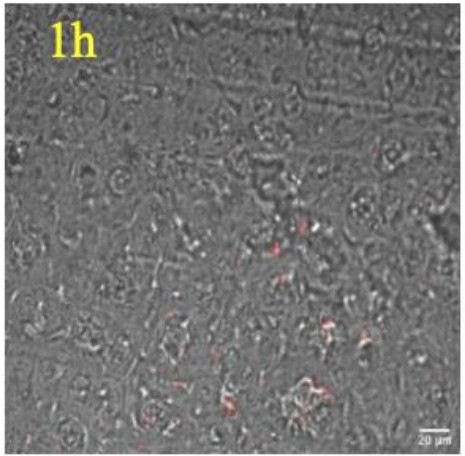
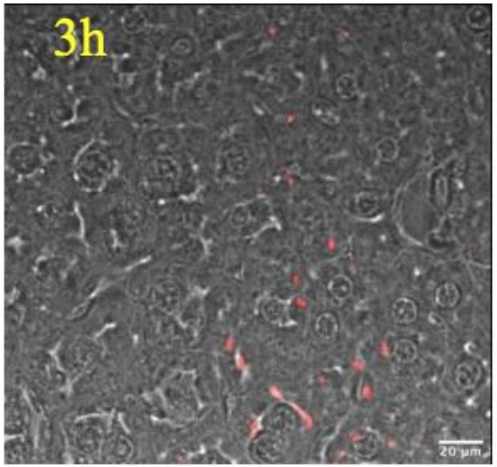
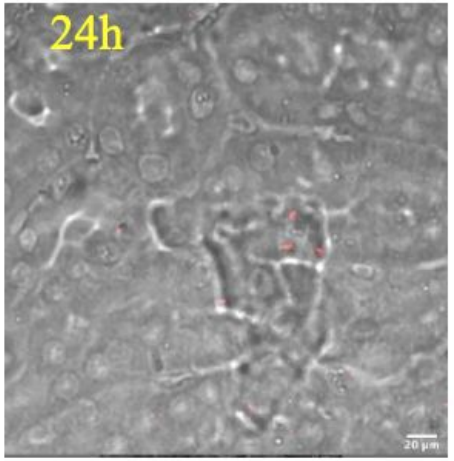
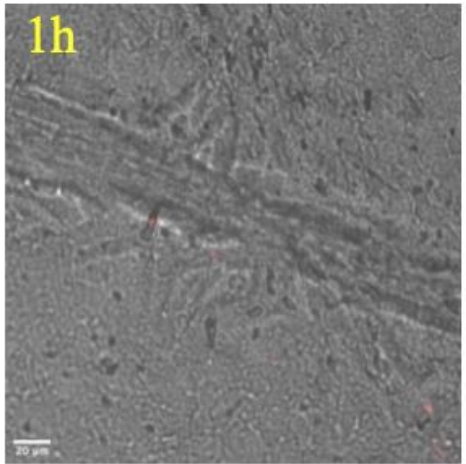
Liver

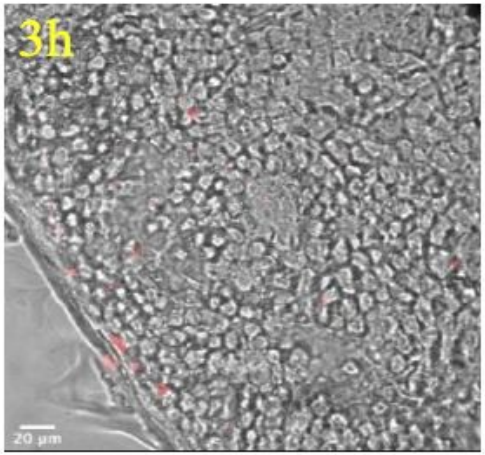


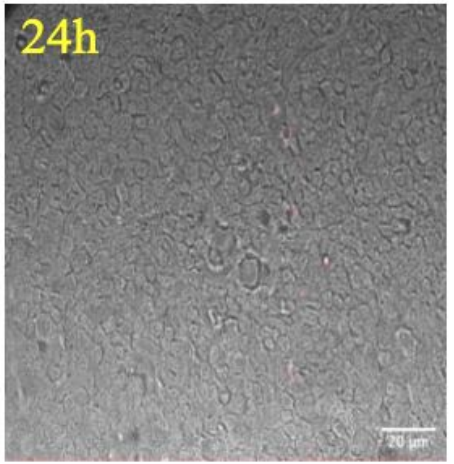




Spleen







Summary/Conclusions

-Tm-GQDs show major promise as bioimaging probes due broad biodistribution/NIR emission across a wide range of targets

-The ability to image live animals without dissecting them can reduce the number of animals sacrificed

-The results suggest future use for image guided drug delivery applications

-Possible modifications: Alteration of the surface of the GQDs with moieties to ensure passage across the blood-brain barrier

Acknowledgements/References

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SciCom Statement

In this work, we use a novel, tiny material that allows us to image biological structures without the detrimental effects of X-rays, CAT scans, and MRI using an infrared light that cannot be seen by the human eye. These materials were tested in mice and show infrared light emission in several organs and their corresponding tissues. These results suggest that the materials show promise for future diagnostic imaging applications for a variety of medical conditions and diseases.