Macrocyclic Chromophores as a Novel Class of Fluorescent Molecules

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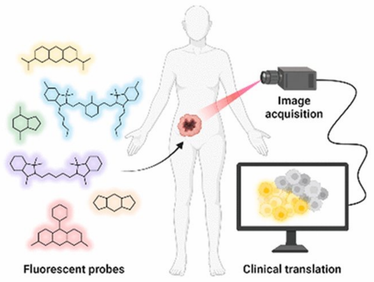
Introduction

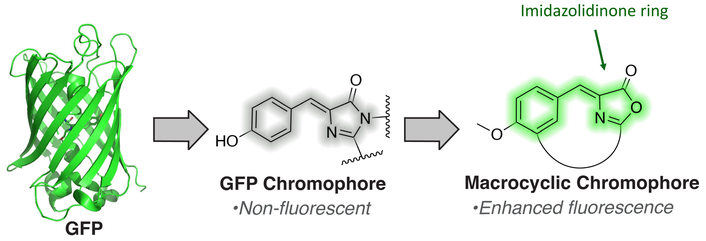
Fluorescence imaging is a novel technique for observing biological targets and visualizing biological processes in real time.



Hoffman, R. M. Laboratory Investigation 2015, volume 95, 432–452.

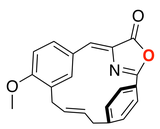
Vendrell, M et al. ACS Nano 2023, 17, 20, 19478–19490.

Green Fluorescent Protein (GFP) is one of the most commonly employed fluorescent proteins in biological imaging



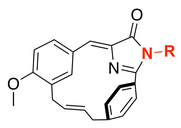
Rotational freedom of the molecule reduces fluorescence emission→ limits ability to develop GFP chromophore as a general scaffold for fluorescence-based imaging techniques

→ **Macrocyclization** can be used to restrict the free rotation of the chromophore to enable fluorescence outside of the protein environment.



Synthetically feasible GFP core

Synthetically feasible oxygen compound may have different optical properties than the natural imidazolidine-based chromophore



GFP-based core

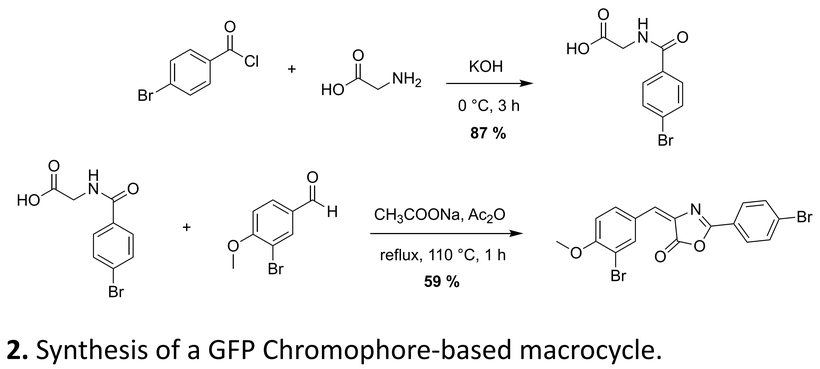
→ Characterization using UV-Vis and fluorescence spectroscopy will allow for comparison of both cores to the optical properties of GFP

Aims

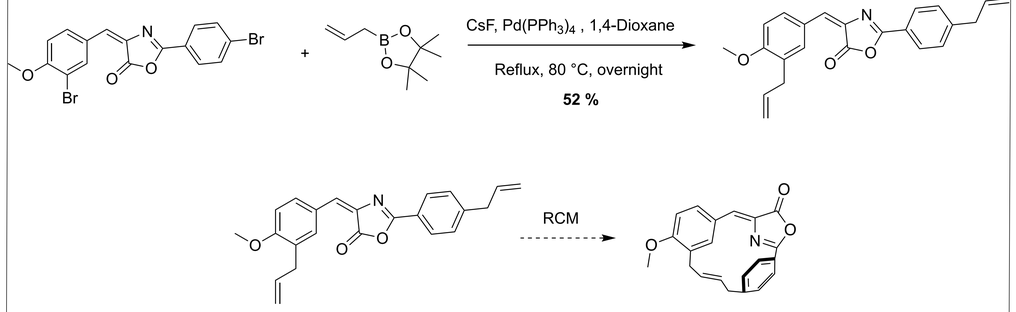
- Synthesize macrocyclic imidazolidinone derivatives
- Perform nitrogen-swapping reaction to synthesize and characterize nitrogen-containing derivative
- Characterize structural and optical properties of synthesized molecules using NMR, UV-Vis, and fluorescence spectroscopy
- Characterize optical properties of synthesized molecules in glycerol solutions with varying viscosities

Methods

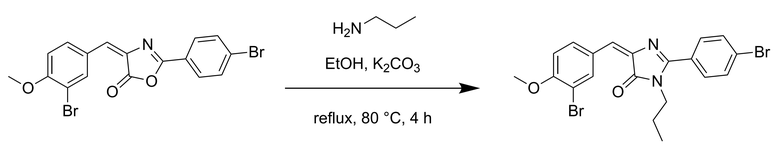
Stage 1. Synthesis of starting materials to prepare the GFP core.



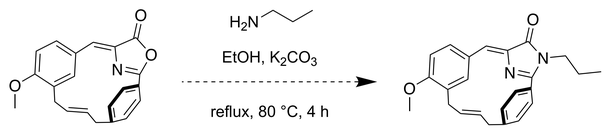
Stage 2. Synthesis of a GFP Chromophore-based macrocycle.



Stage 3. Nitrogen substitution reaction on the linear compound.

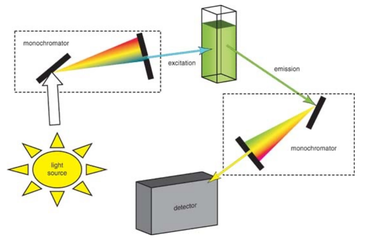


Stage 4. Nitrogen substitution reaction on macrocyclic structure.



Future Direction

- NMR spectroscopy to confirm structures
- UV-Vis and fluorescence spectroscopy to characterize optical properties
- Characterization of fluorescence in glycerol solutions



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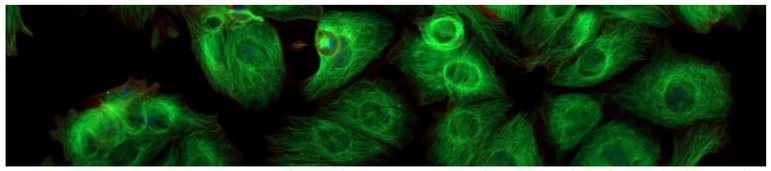
Conclusions

The findings of this research have the potential to result in the development of new imaging techniques that will advance current capabilities of biological imaging strategies and improve our understanding of biological processes in living systems!



Newsletter: *Fluorescent proteins: advantages and disadvantages.* FluoroFinder.

Acknowledgements

Principal Investigator:
Dr. Brittany White-Mathieu

Graduate Students:
Thomas DiPhilippo
Saghar Jarollahi
Paige Ring
Yağmur Altunsoy

Postdoc:
Dr. Aakriti Garg

Undergraduates:
Nicholas Mixon
Aliyah Krestalica
Samuel Moreau
Madison Pageau

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