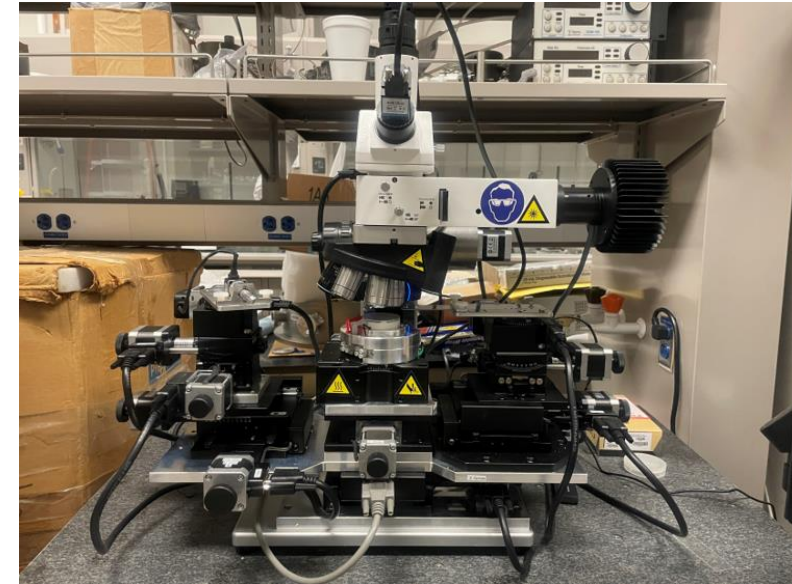
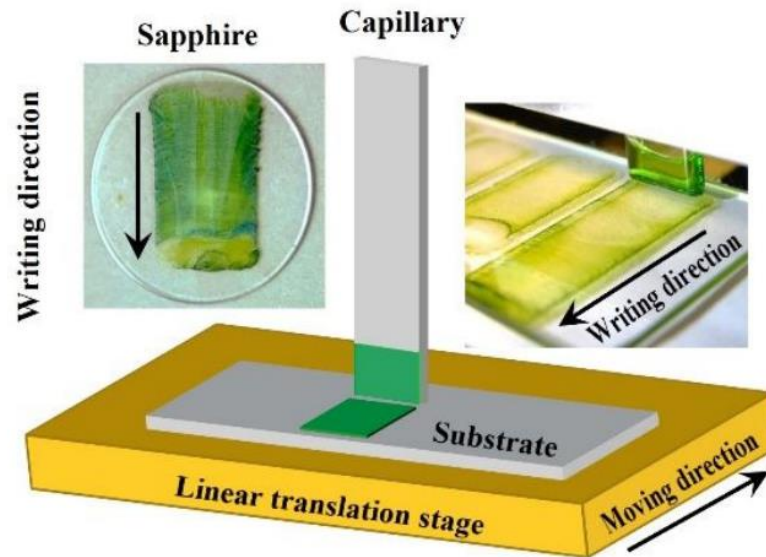
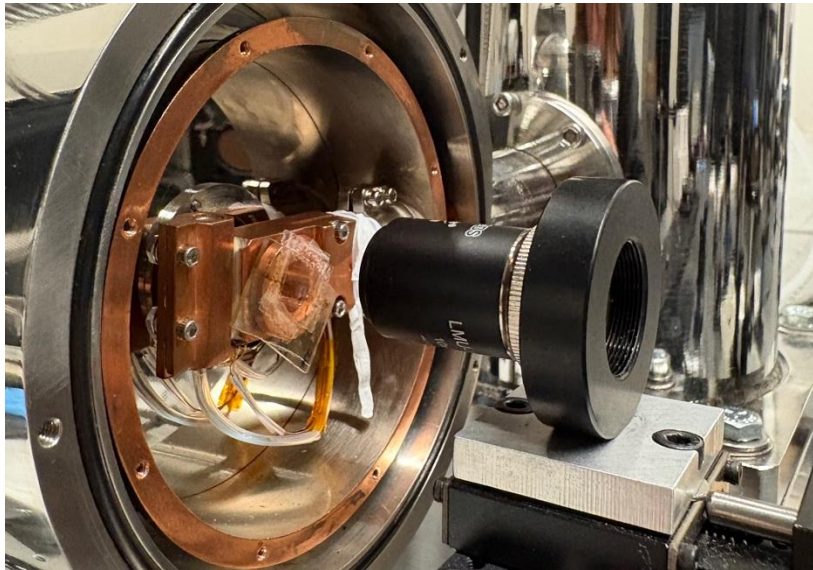




Optical Investigation of Quadrupolar Fluorescent Dye with Phthalocyanine Heterojunctions



Presenting : Jiawen Lin

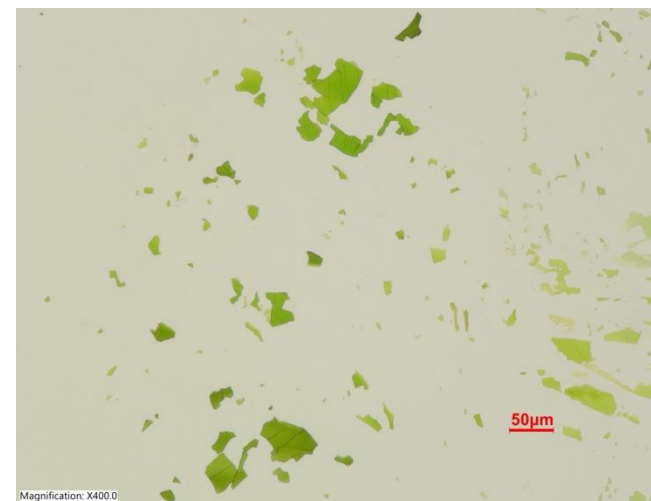
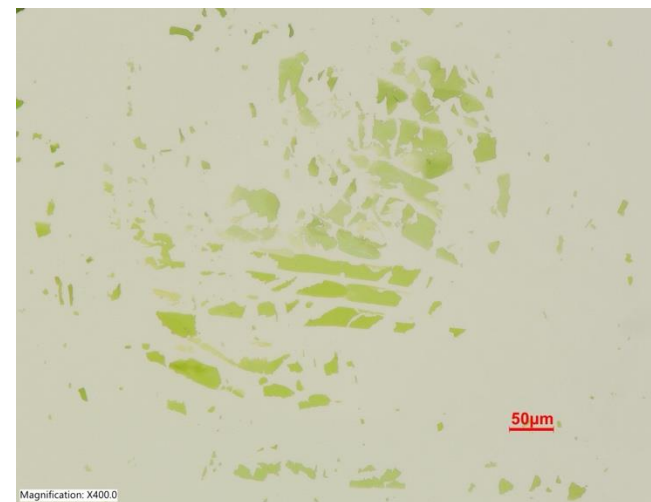
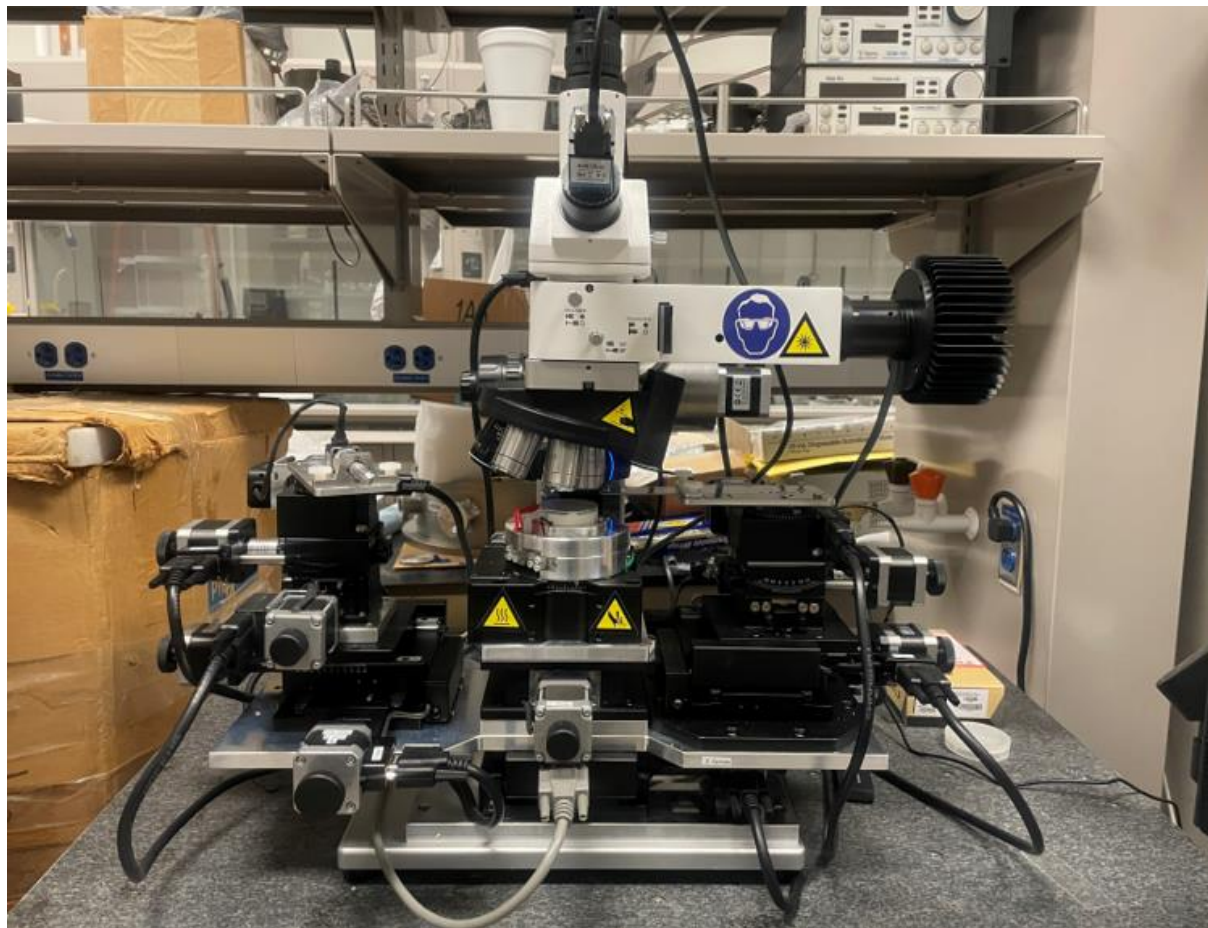
Research Group: Dr. Furis Group (Condensed Matter Physics)

jiawen.lin-1@ou.edu

*Homer L. Dodge Physics & Astronomy Department
Center for Quantum Research Technologies
University of Oklahoma*



Motivation



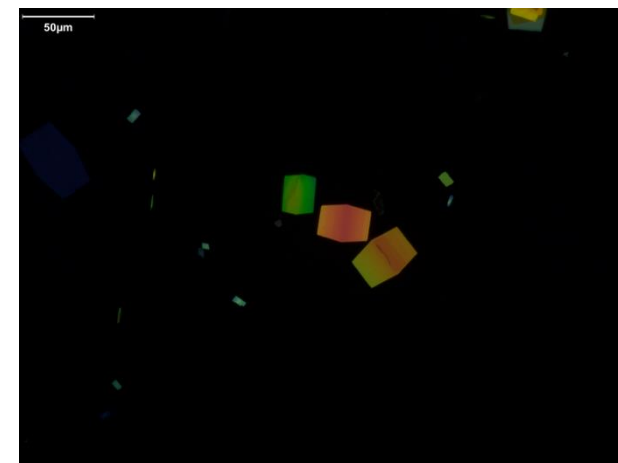
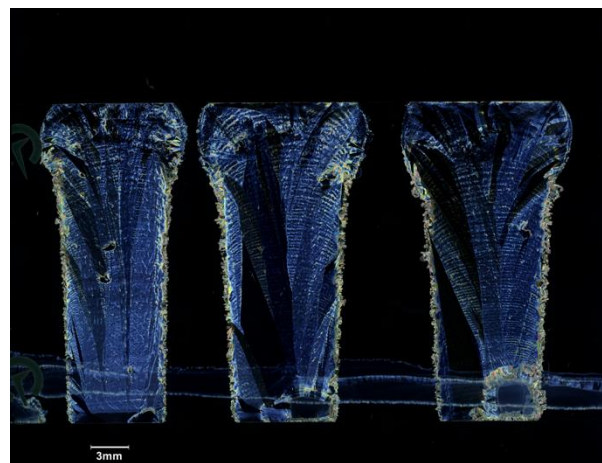
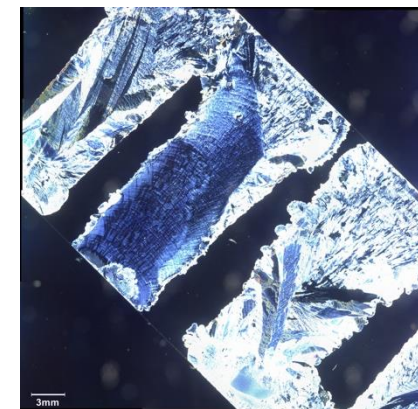
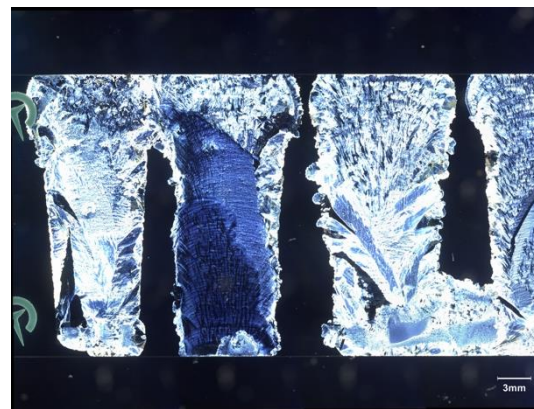
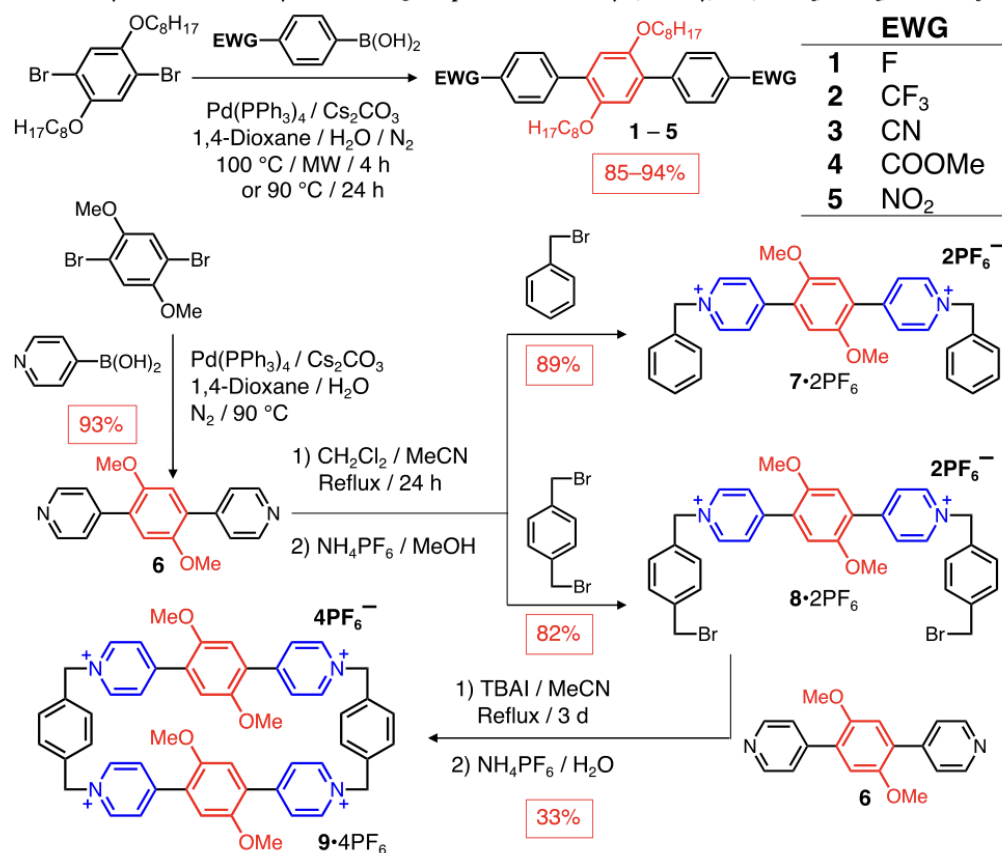
- Highly luminescent organic dyes are promising for photonic applications.
- Thin crystalline films provide better optical properties.
- Therefore, we aim to fabricate high-quality heterojunctions.



Materials Studied (Dye3,4 & 5)



Scheme 1. Synthesis of the Alkoxy-Substituted Quadrupolar Fluorescent Dyes, Namely, 1–6, 7·2PF₆[−], 8·2PF₆[−], and 9·4PF₆[−]



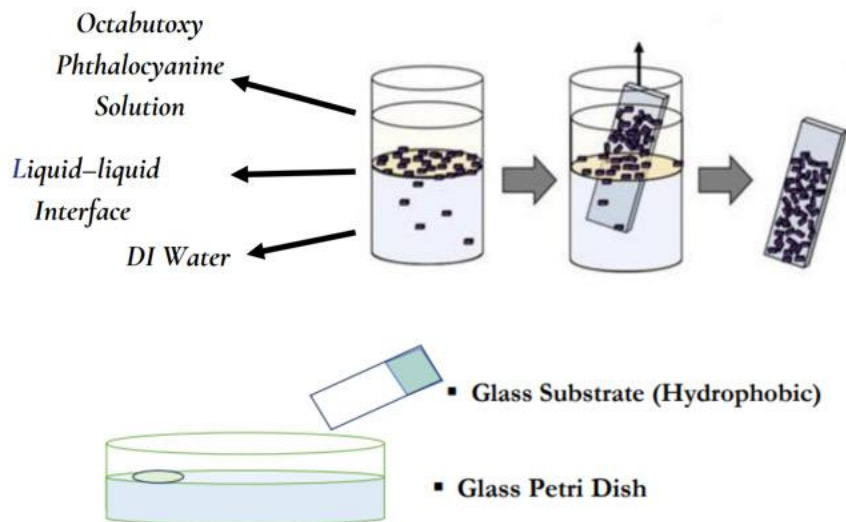
Dye 3, Dye 4 and Dye 5:

They are highly luminescent molecules that can form crystalline flakes, which makes them suitable for heterojunction fabrication.

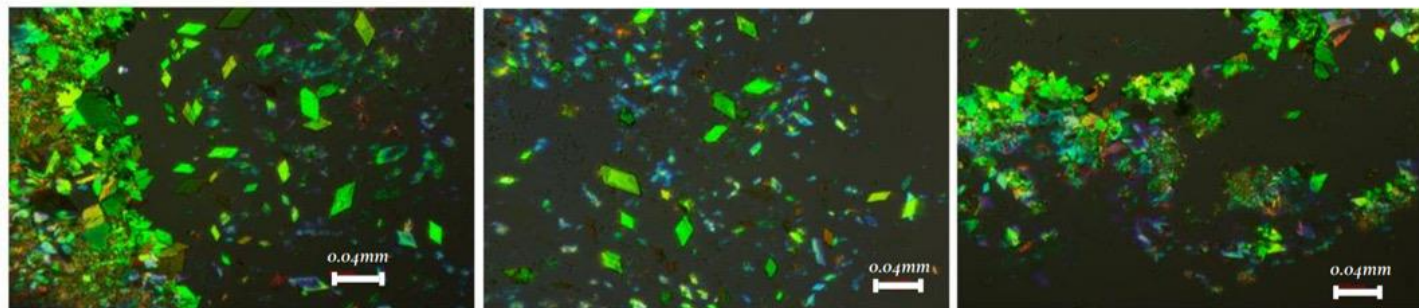
Feng, Y.; Das, P. J.; Young, R. M.; Brown, P. J.; Hornick, J. E.; Weber, J. A.; Seale, J. S. W.; Stern, C. L.; Wasielewski, M. R.; Stoddart, J. F. **Alkoxy-Substituted Quadrupolar Fluorescent Dyes**. *J. Am. Chem. Soc.* **2022**, *144* (37), 16841–16854. <https://doi.org/10.1021/jacs.2c04906>



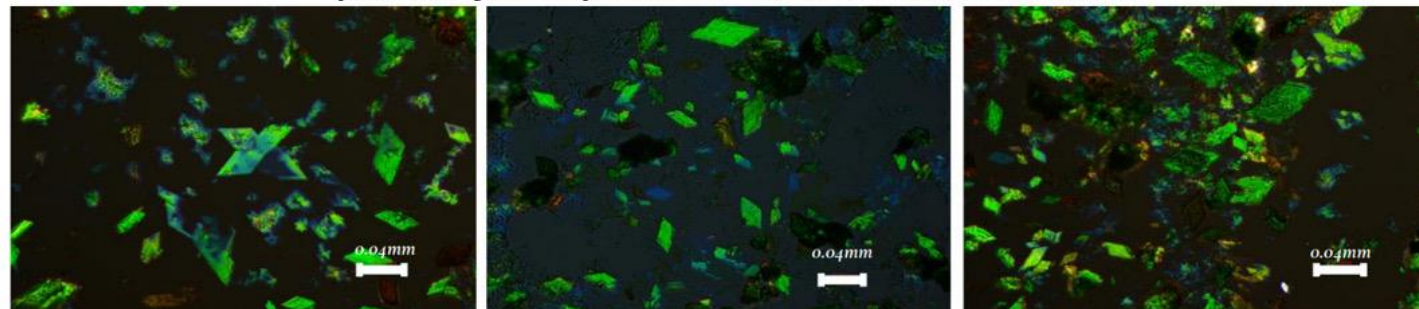
Previous Work



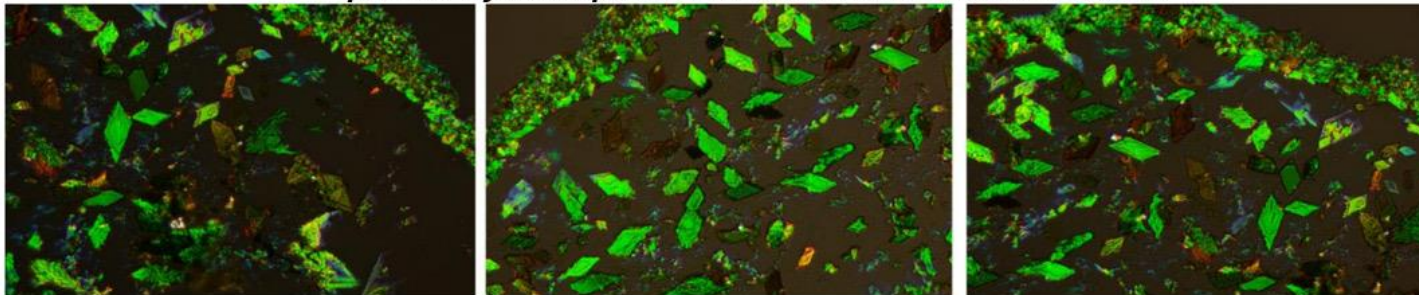
0.075% (3Hrs, Aqueous Subphase: DI Water) Crystal morphology of phthalocyanine precursor at 0.075% concentration.



0.0375% (6Hrs, Aqueous Subphase: DI Water) Crystal morphology of phthalocyanine precursor at 0.0375% concentration.



0.01875% (6Hrs, Aqueous Subphase: DI Water) Sparse crystal formation of phthalocyanine precursor at 0.01875% concentration.



Question

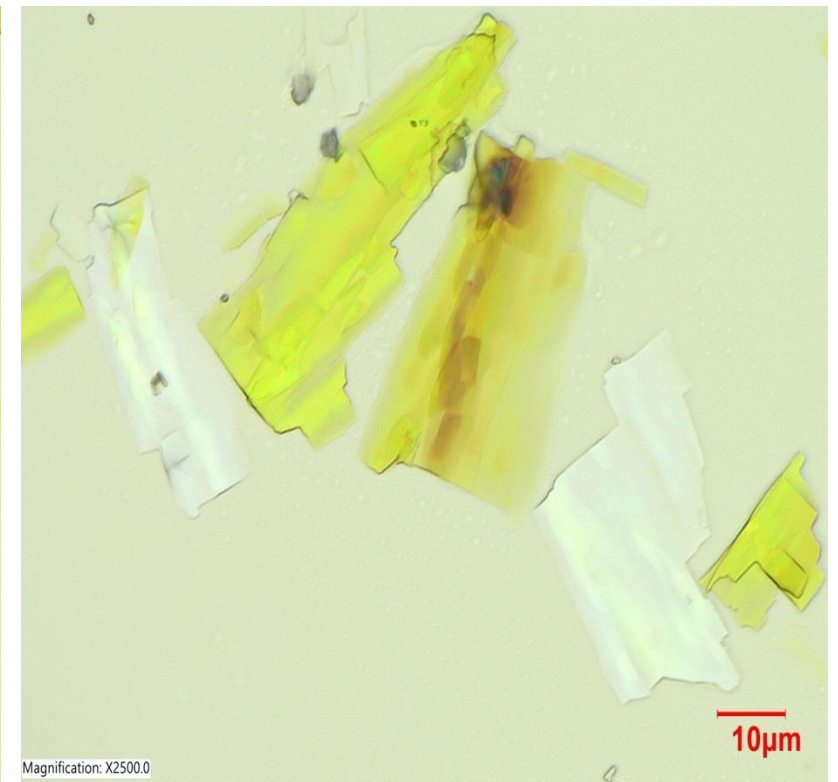
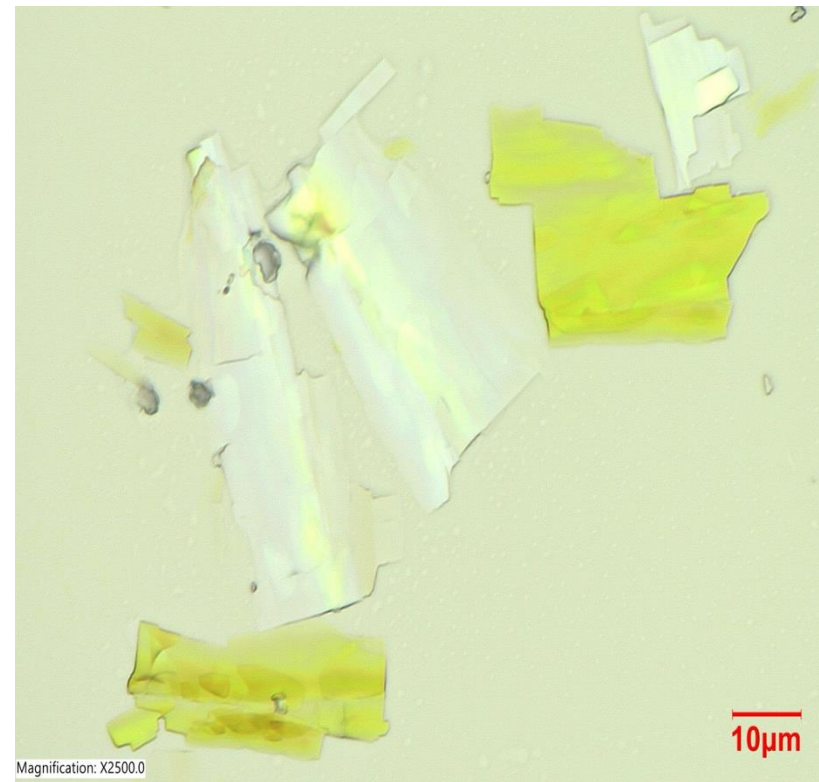
Can liquid-liquid interface assembly produce similarly high-quality flakes of a quadrupolar fluorescent dye?



Representative Optical Microscope Images of Dye4

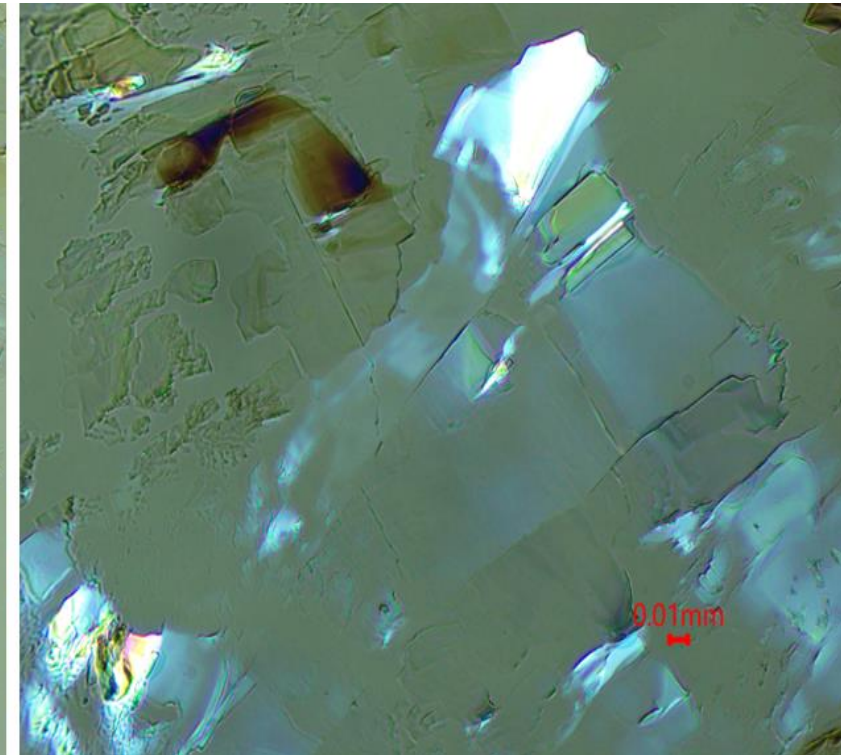
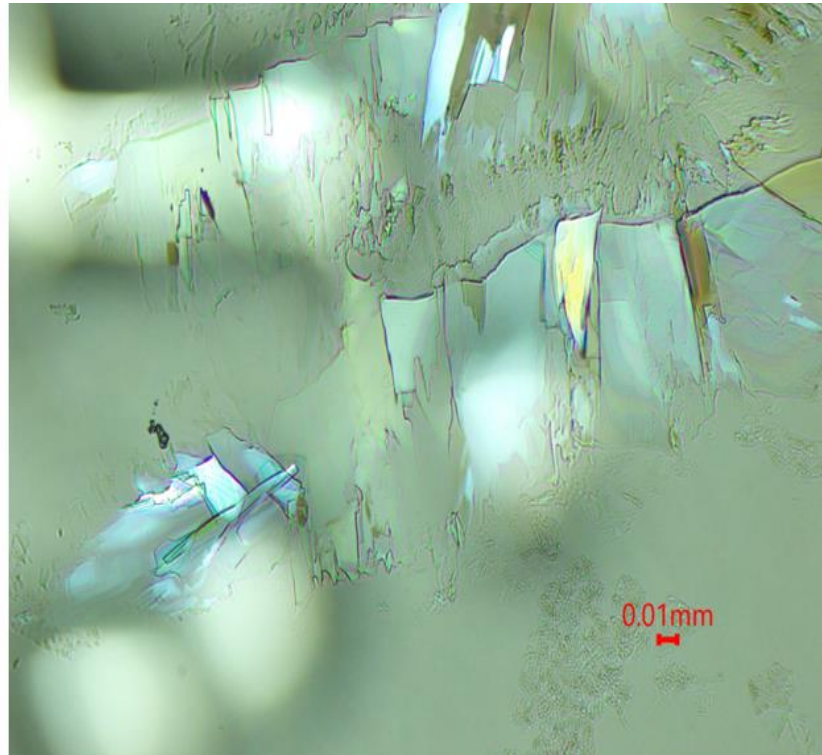
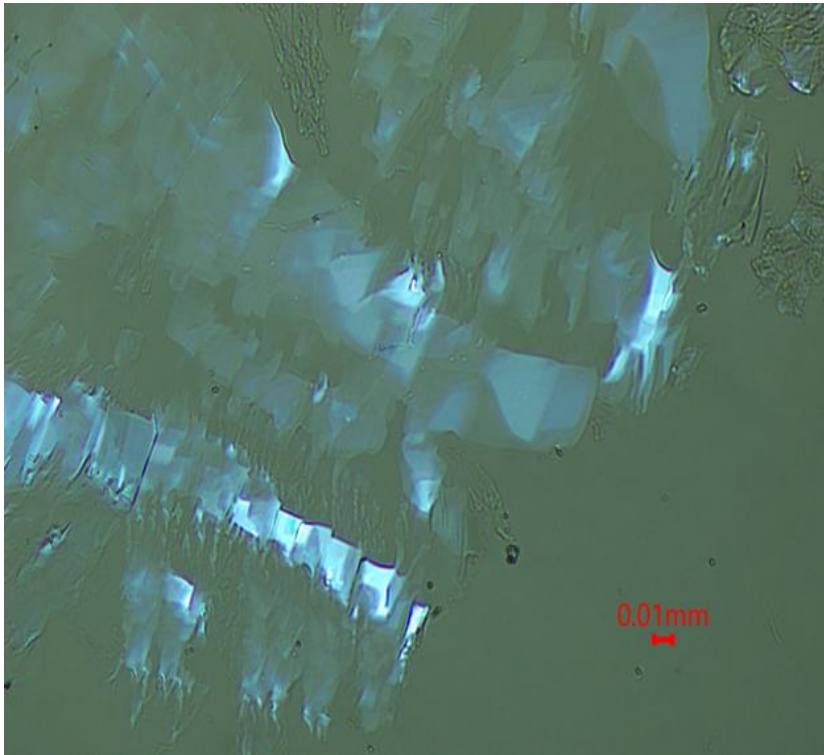


- 0.05% concentration for 1day





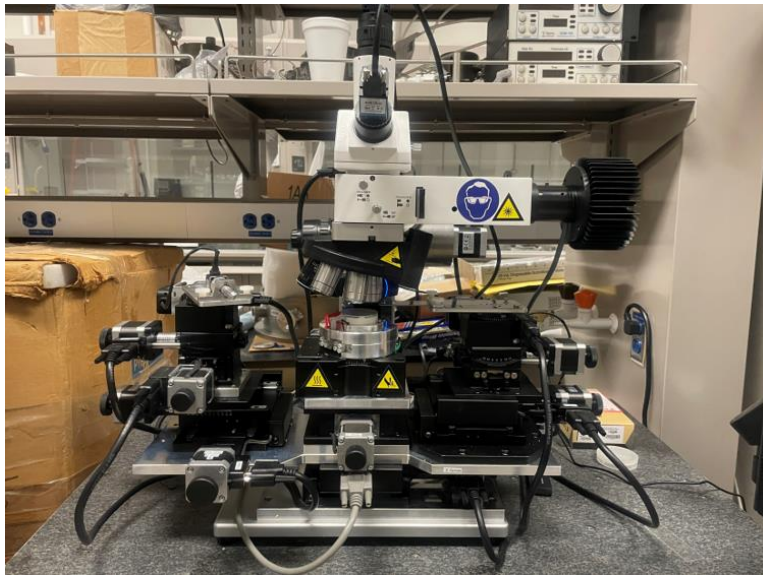
Representative Optical Microscope Images of Dye5



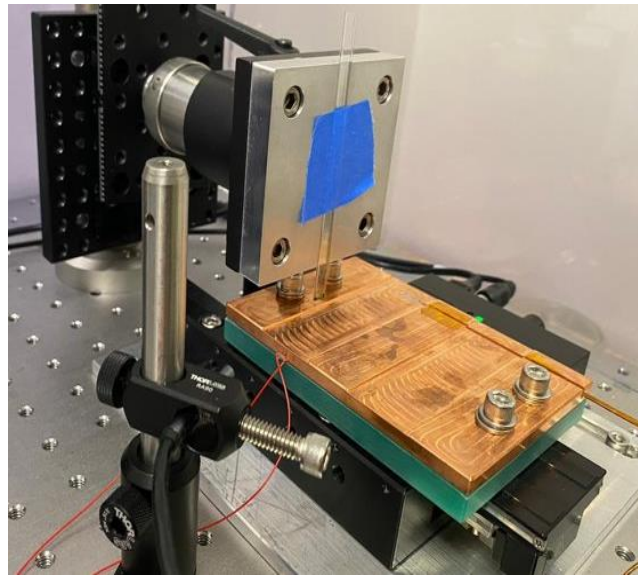
- Dye5: 0.025%
- As shown in these optical microscope images, the method successfully produced large, thin, and flat Dye 4/5 flakes.



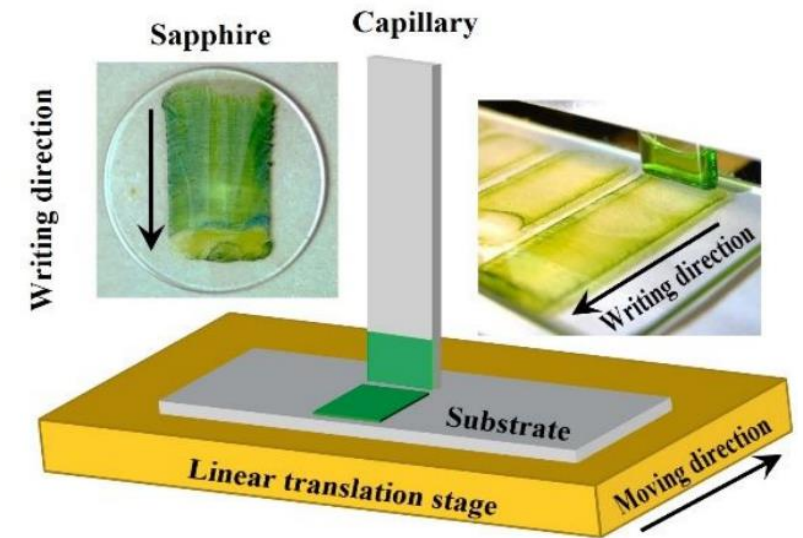
Heterojunction Fabrication Procedures



2D Transfer Machine



Pen Writing Stage

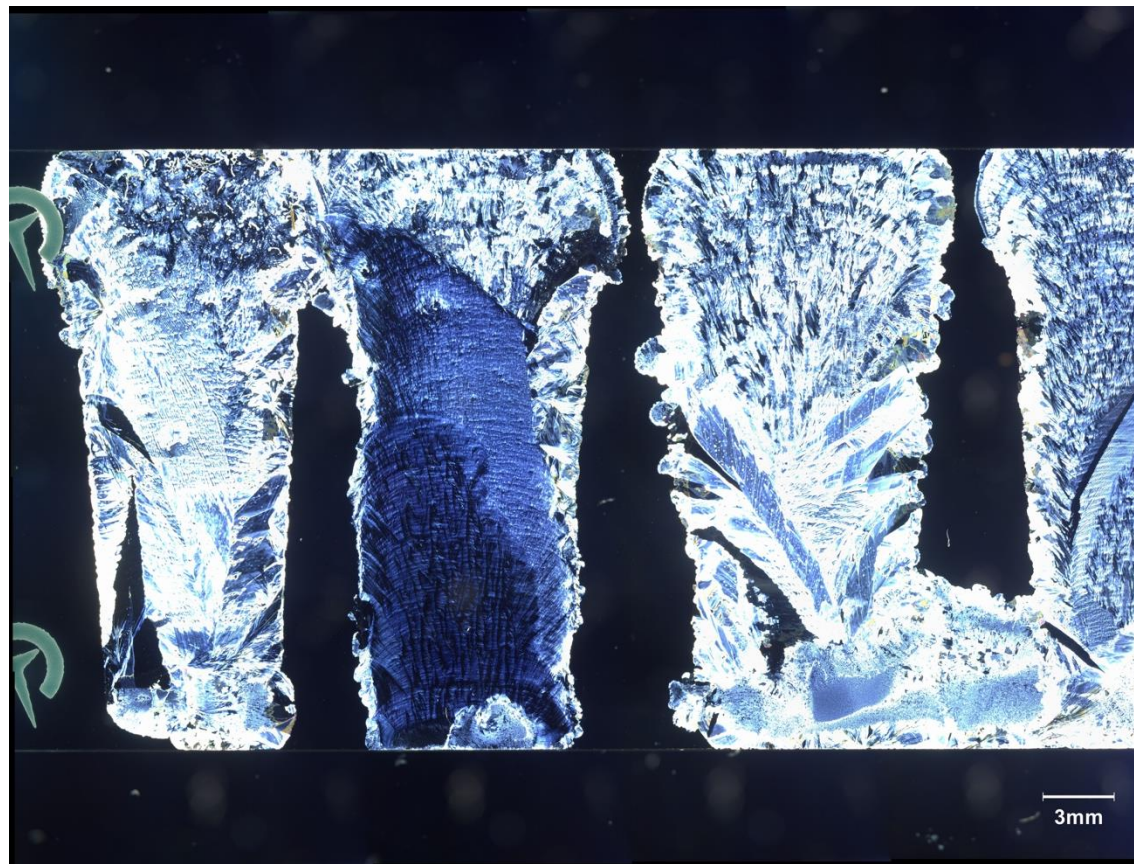
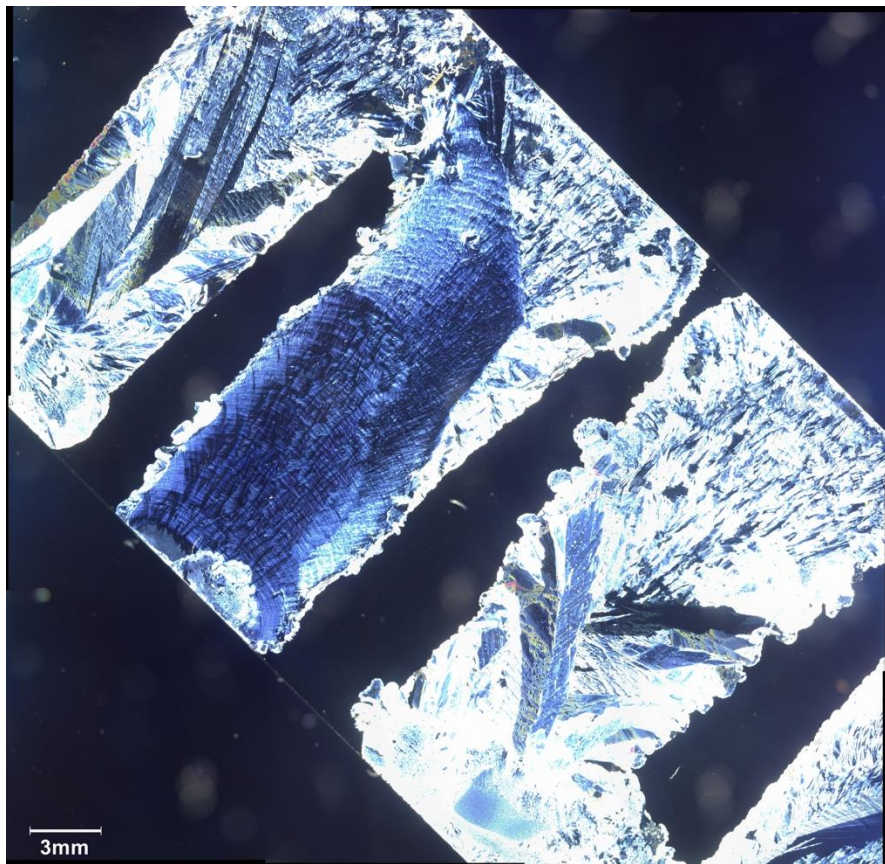


Thin Film Making

* Wo, S., R.L. Headrick, Journal of Applied Physics 2012, 111(7): p. 073716.

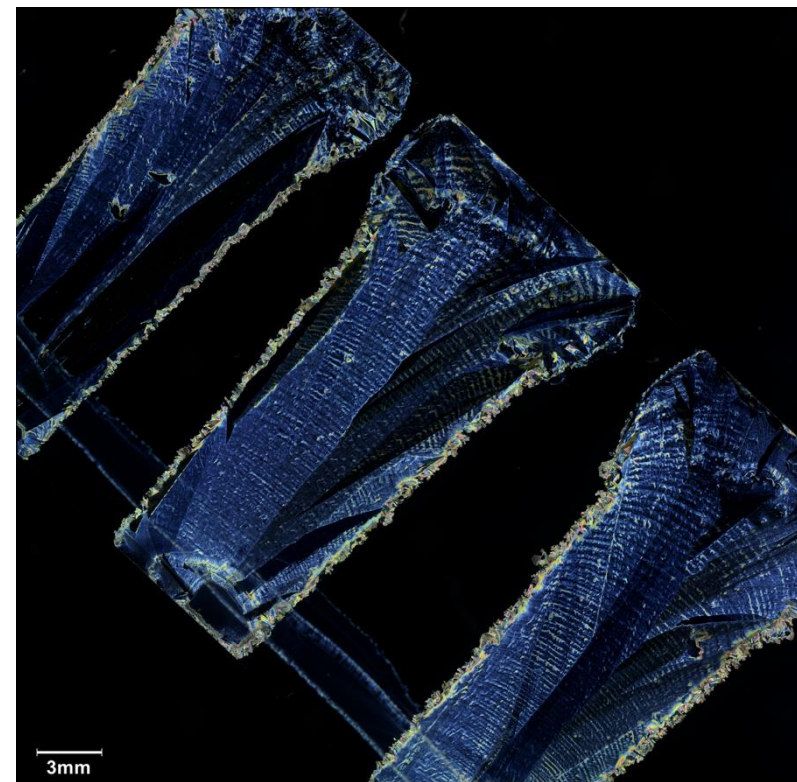
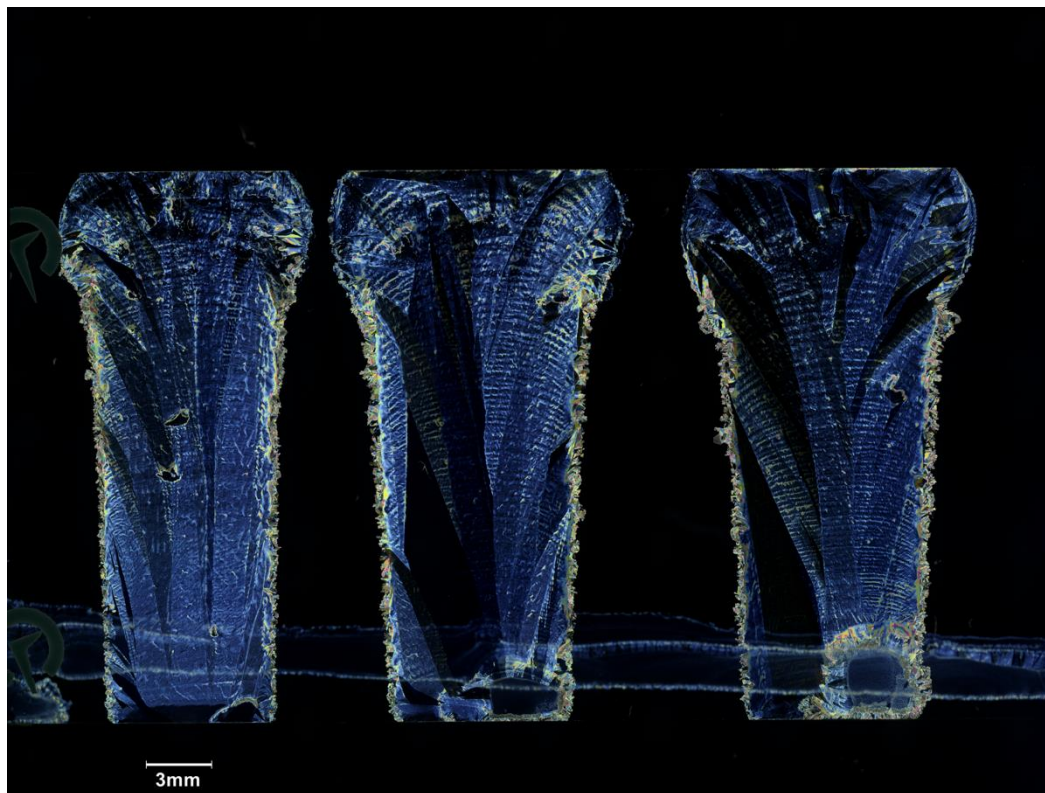


Feng Dye 3 Pen-Written Thin Films



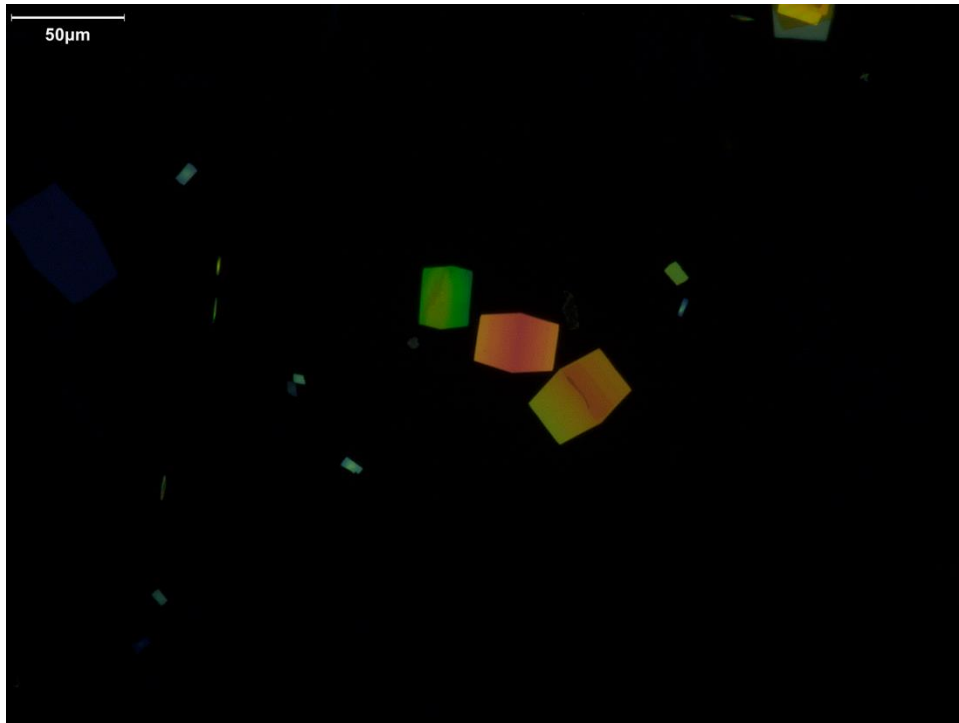


Feng Dye 4 Pen-Written Thin Films





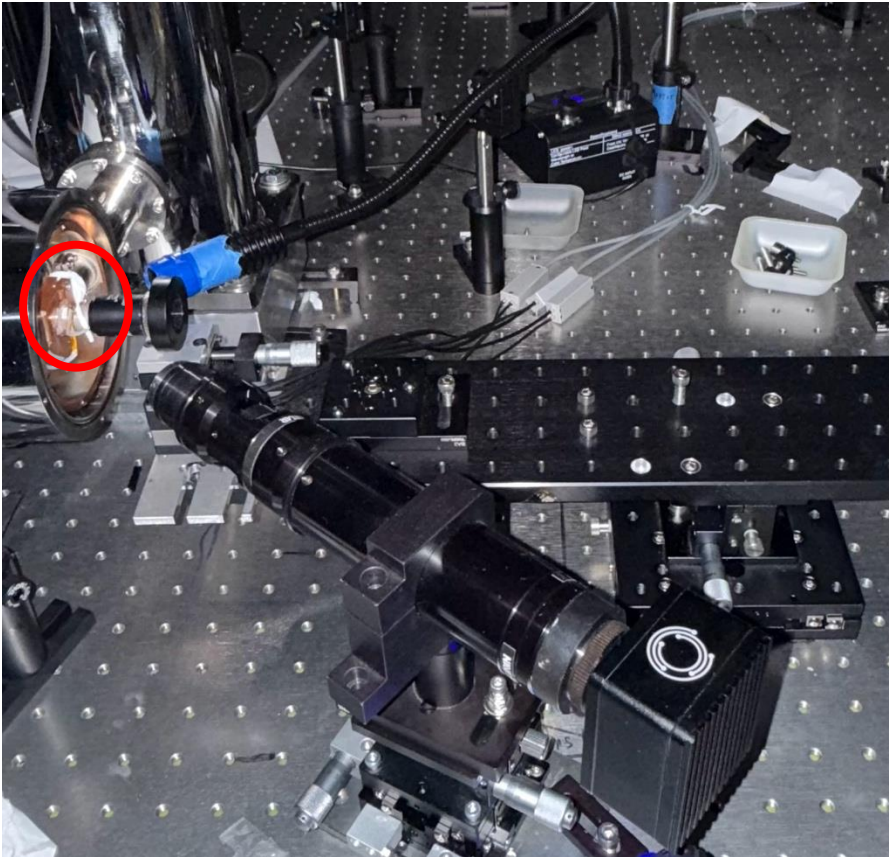
Feng Dye 5 Pen-Written Crystals



- Birefringence images of Feng Dye 5 single crystals prepared using the pen-writing technique, with the polarizer and analyzer rotated between images



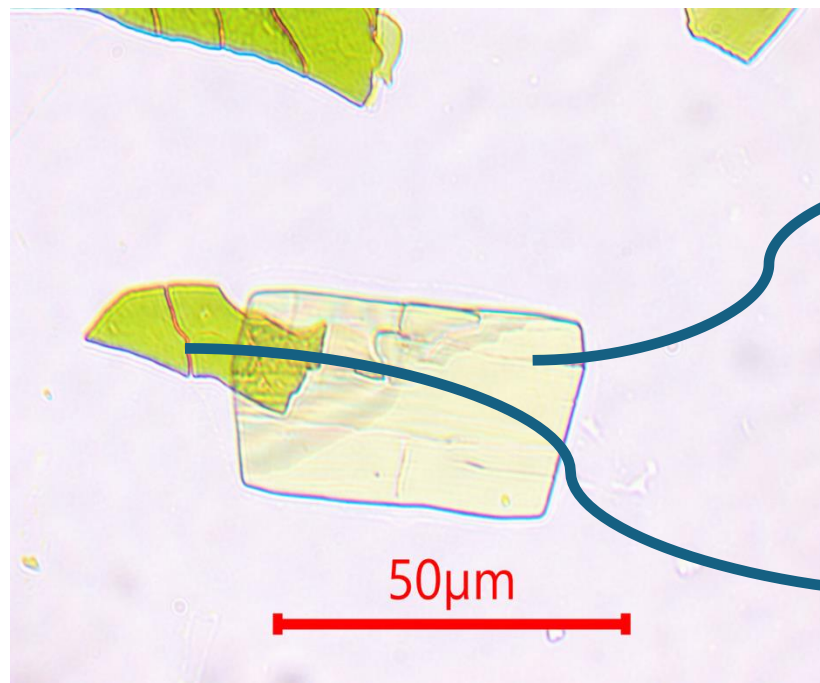
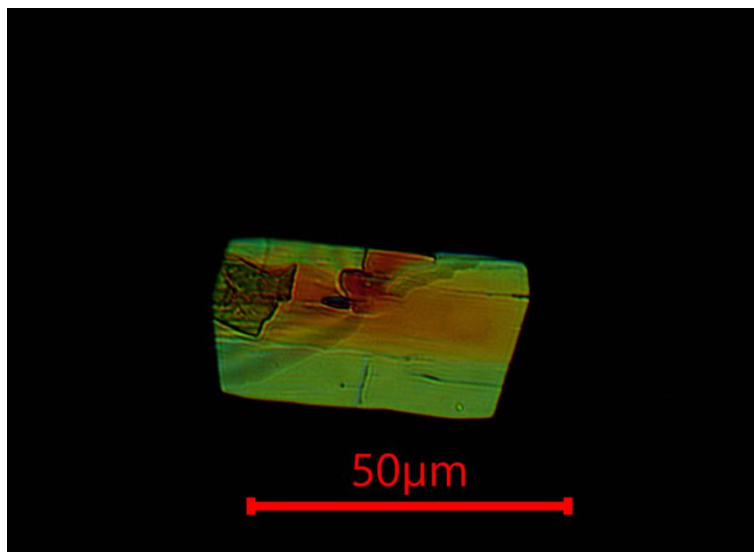
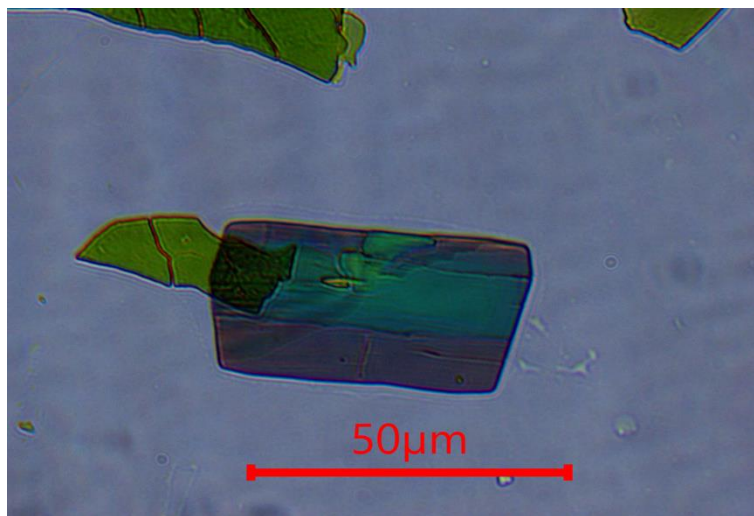
PL Measurement Setup



- This telescope allows us to precisely identify and focus on the overlap region before collecting the PL signals



Heterostructure Fabrication



Dye 5 Flake

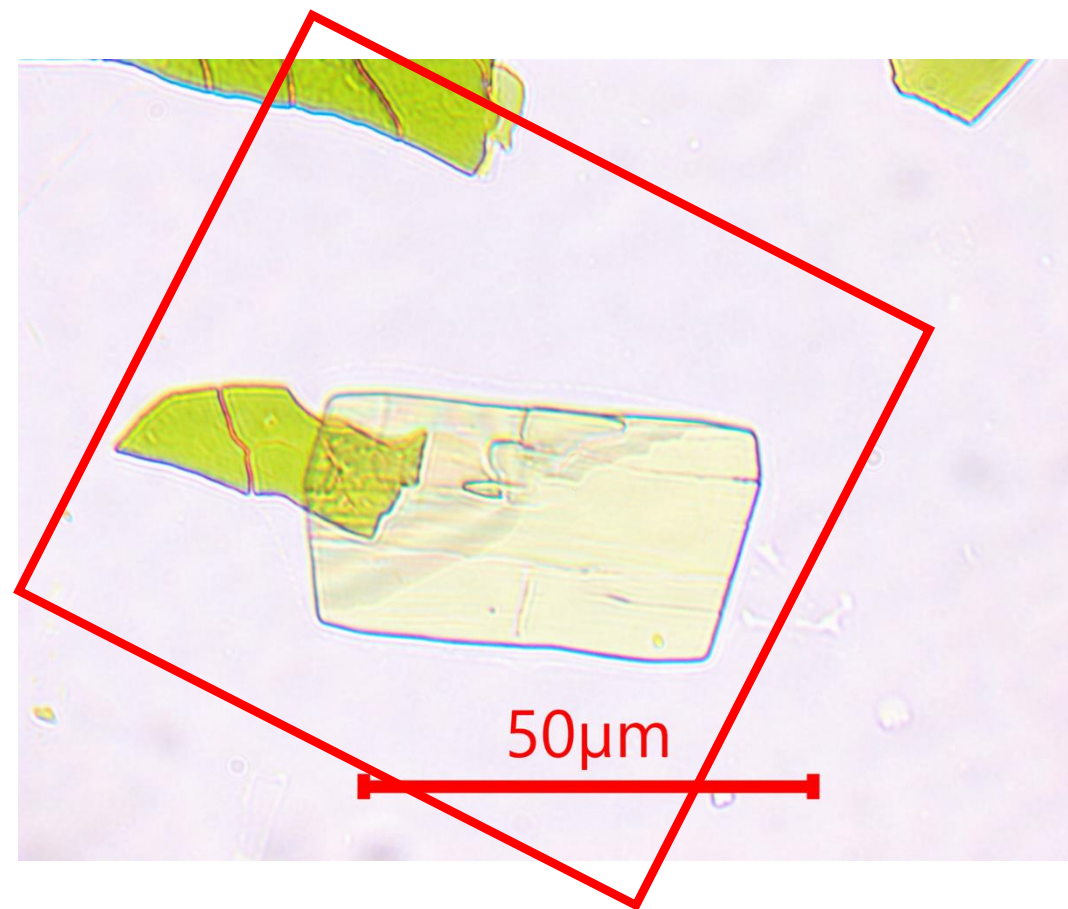
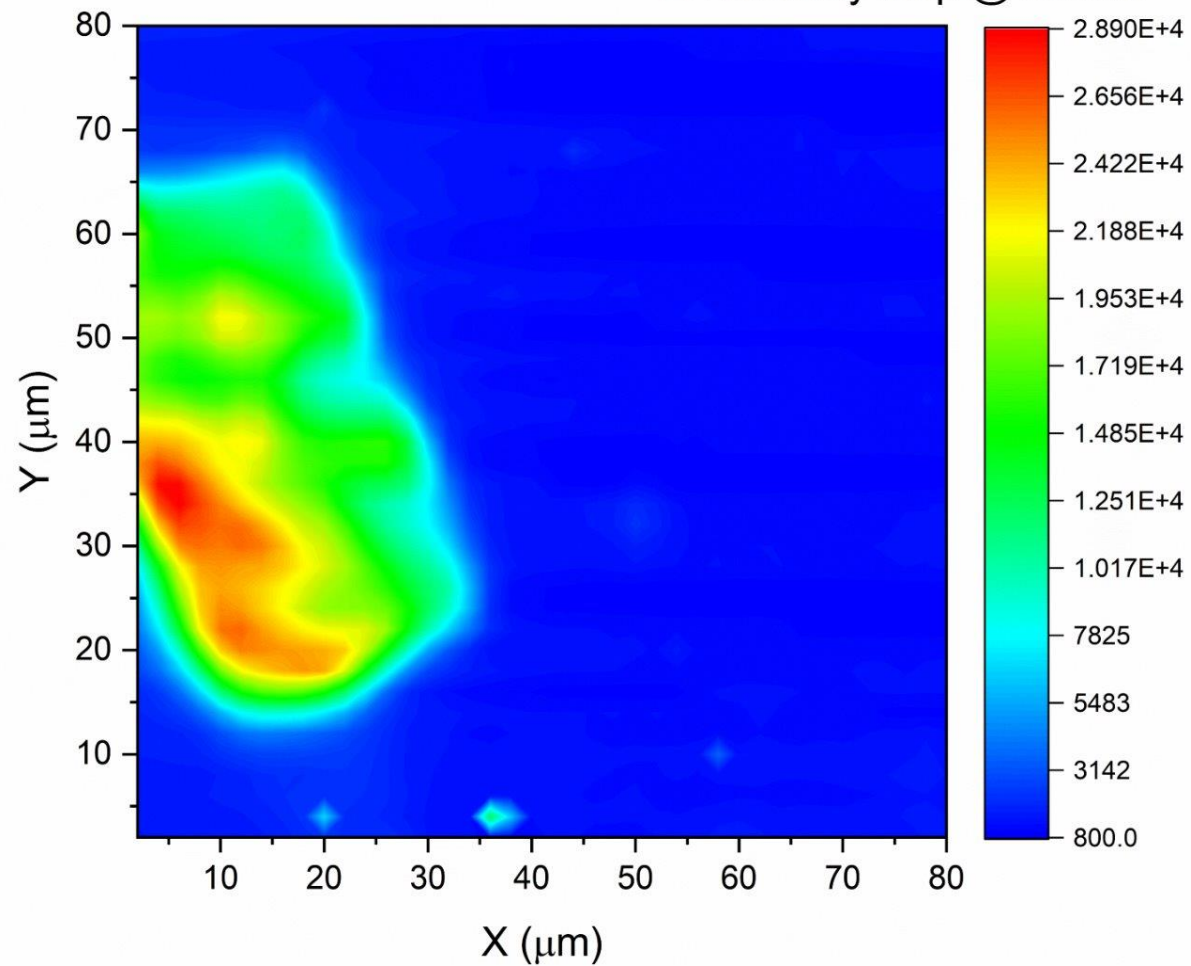
Phthalocyanine Flake

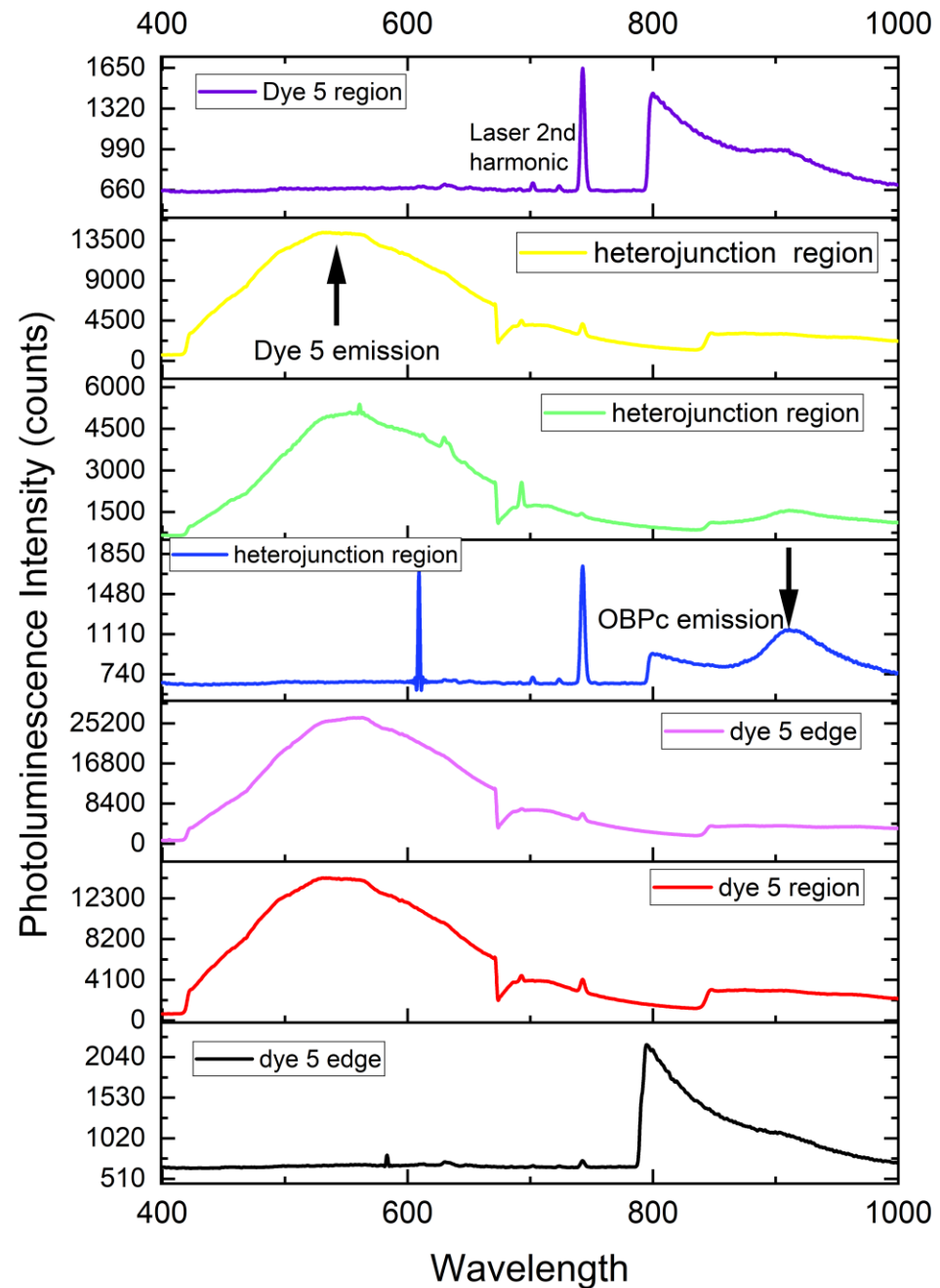


PL Intensity Map



PL Intensity map @ 520nm





PL Intensity VS. Wavelength Spectrum



Future Work



- Perform PL intensity mapping using the 920nm emission
- Compare the spatial distribution of the 520nm and 920nm emission
- Investigate the correlation between the two emission bands
- Better understand the optical interactions within the heterostructure

Thank You !