Novel Piezochromic Materials for NASA Pressure Systems

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Introduction

- High-risk pressurized systems are routinely used for ground-based and in-flight operations in all NASA testing/research facilities.
- As of 2024, there are approximately 10,000 ground-based pressure vessels and systems (PVS) that operate in NASA facilities [1].
- While use of these pressure systems is imperative for NASA operations, they pose an immense safety risk if not operated or maintained properly.
- Pyrylium salts have been widely investigated for their unique synthetic utility in natural product synthesis as well as their attractive photoluminescent and lasing properties [2-5].
- Pyrylium salts are recently discovered pressure-sensing materials that exhibit piezochromism [6].

Objectives

- To synthesize and characterize pressure sensitive pyrylogen ditosylate salts.
- Synthesize novel pyrylogen salts utilizing a greener, safer method compared to methods in the literature.
- Measure piezochromic properties using a diamond anvil cell (DAC)
- Measure the fluorescence of the fused and non-fused pyrylogen ditosylates in methanol

References

[1] NASA OSMA 2024. Pressure Systems. https://sma.nasa.gov/sma-disciplines/pressure-vessels-and-systems.
[2] J. Ortyl, et al. (2021) Eur. Polym. J., 150, 110365.
[3] L. Resta, et al. (2021) Org. Biomol. 19, 943-957.
[4] Y. Sagara, et al. (2016) Adv. Mater., 28, 1073-1095.
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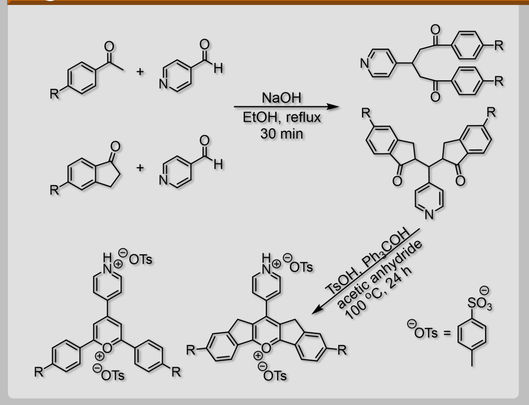
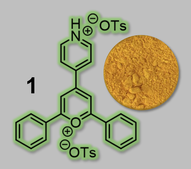
[6] P. Canasa, et al. (2024) Small Sci., 4, 2400106.

Synthetic Methods



Scheme 1.



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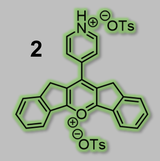

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Results

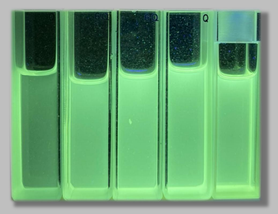

Figure. Quartz cuvettes containing **(1)** dissolved in methanol from 1-5 x 10^{-5} M under 355 nm light.

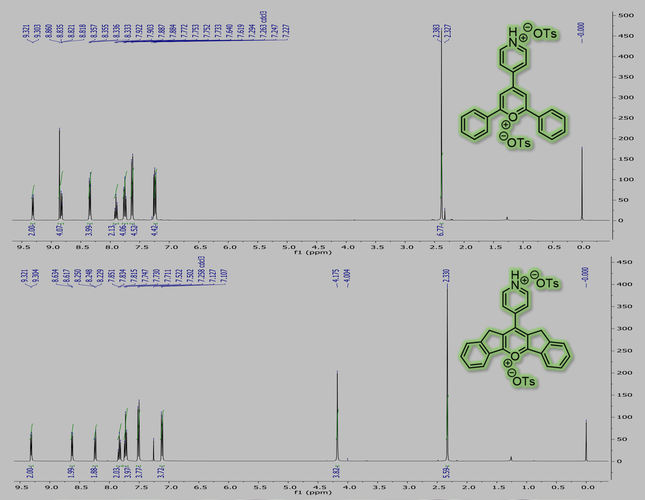

Figure. ^{1}H NMR spectra of **1** and **2** recorded in $CDCl_3$/TFA.

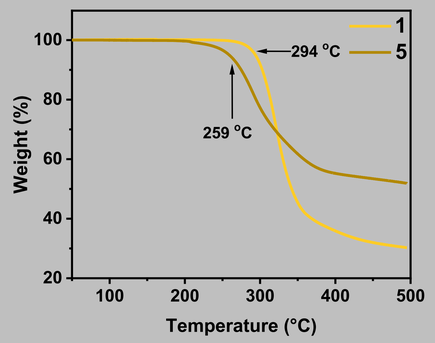

Figure. TGA thermogram of **1** and **2** at heating rate of 10 °C/min in nitrogen. T_d = 294 °C (**1**) and 259 °C (**2**).

Conclusions

Future Work

Acknowledgements

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