

Progress Towards Phenazine Aggregation Induced Emitters

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Introduction and Background

Luminescent materials are compounds that emit light without being heated. Many π -conjugated organic molecules absorb and emit (fluoresce) light, however most molecules that fluoresce in solution lose their fluorescence when aggregated.

Aggregation Caused Quenching (ACQ) largely occurs when flat conjugated molecules π stack on top of each other. In the aggregated state they are able to dissipate energy between molecules as thermal or kinetic energy instead of releasing it as light.

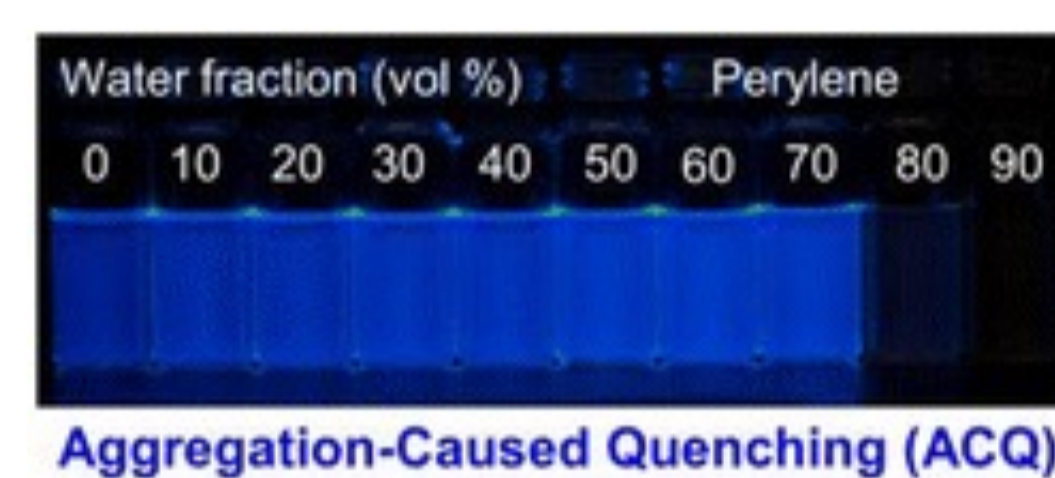
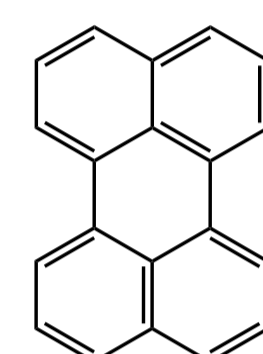
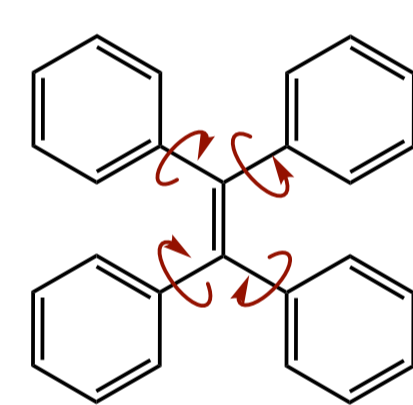
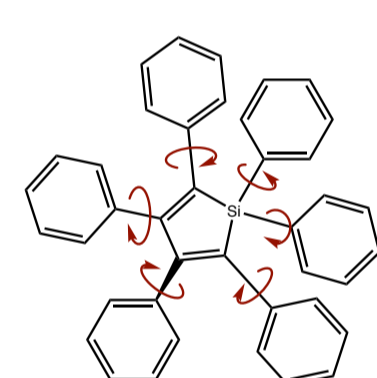
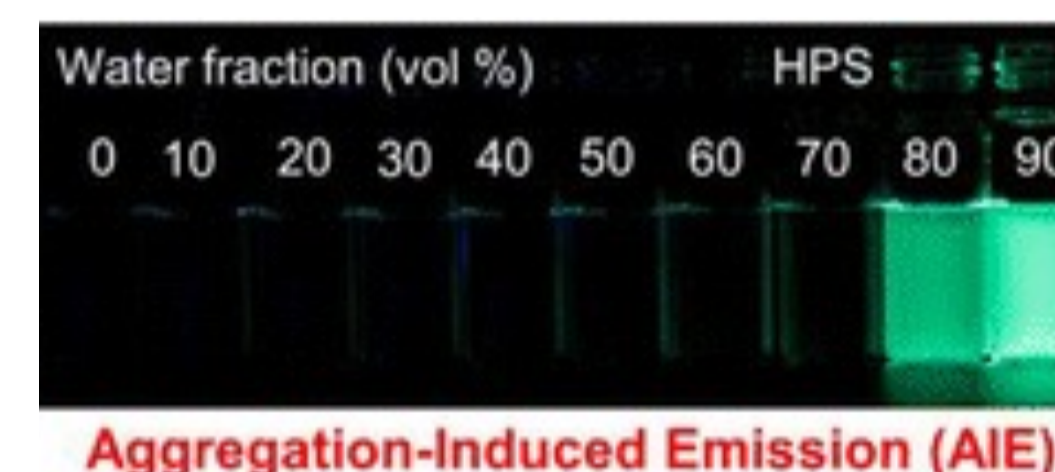


Figure 1. This image shows how most π -conjugated organic molecules quench, or lose fluorescence when aggregated.¹



Recently scientists have discovered molecules that behave the opposite: do not fluoresce in solution, but rather **fluoresce when aggregated**.

Figure 2. This image shows how molecules like TPE gain fluorescence when they are aggregated.¹



Tetra-phenylethylene (TPE)

Tetra-phenylethylene (TPE) is one of the most common Aggregation Induced Emission (AIE) lumitogens. Its constrained and bulky structure allows it to rotate freely in solution and not fluoresce, however when aggregated its constrained bulky groups allows it to avoid π -stacking and will fluoresce.

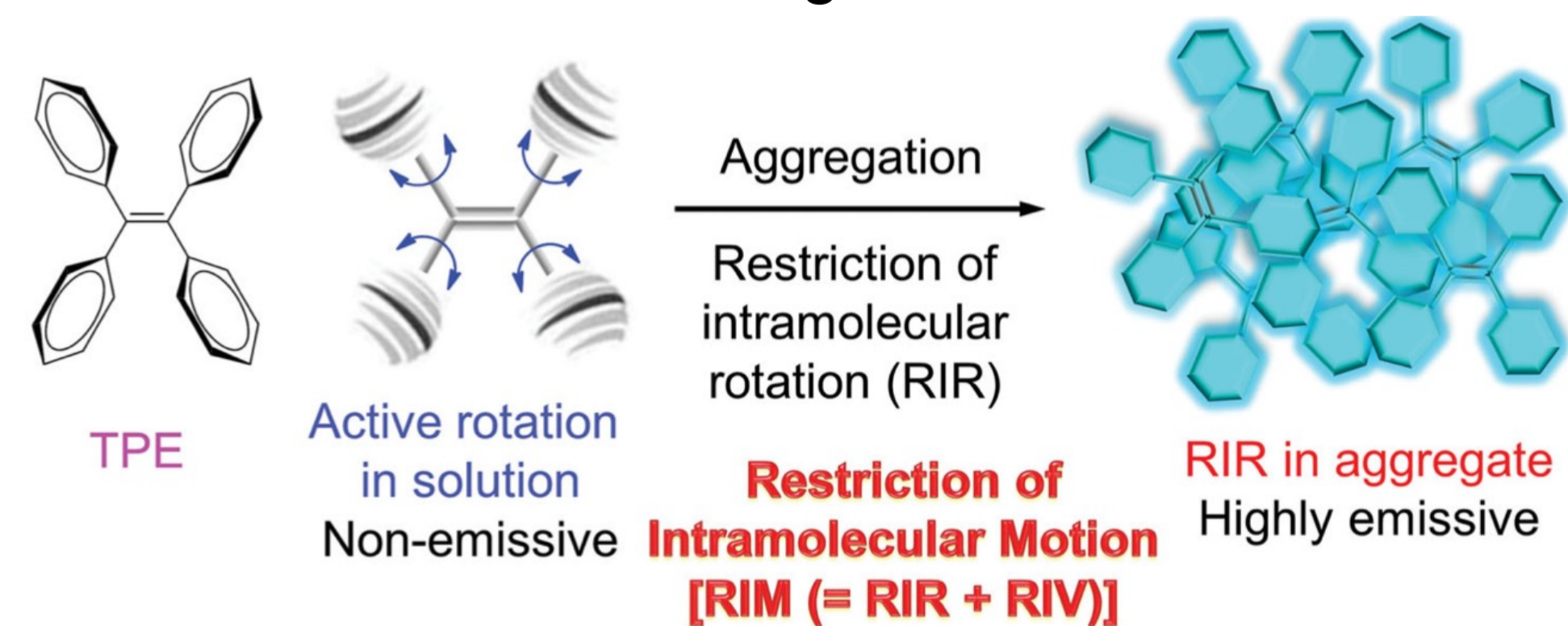


Figure 3. The structure and mechanism of TPE and its AIE behavior.²

There are numerous applications for AIEs

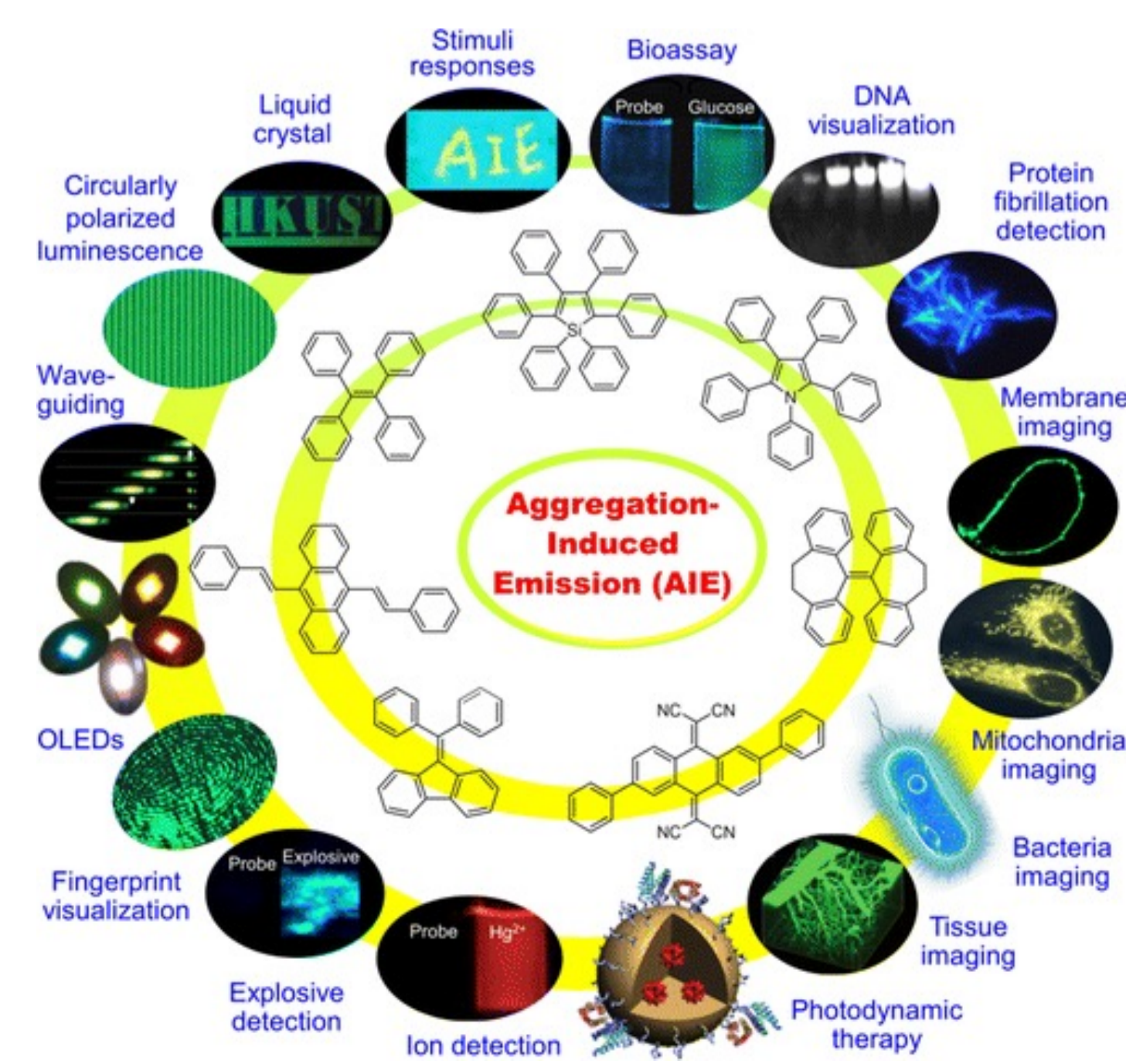
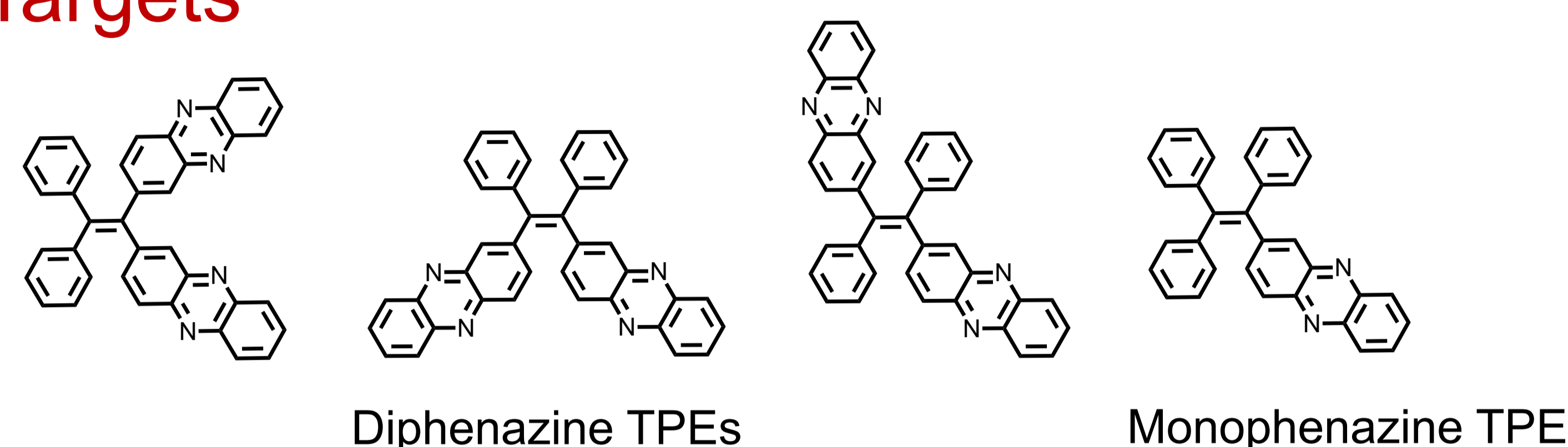


Figure 4. The applications of AIEs.¹

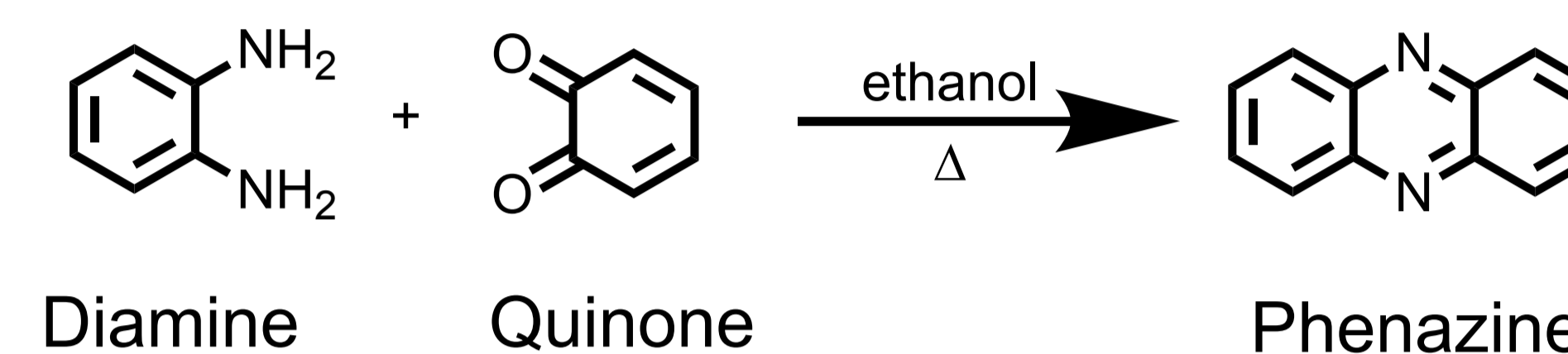
Goal

Incorporate phenazines into TPE structure to investigate its impact on AIE behavior and optical properties

Targets

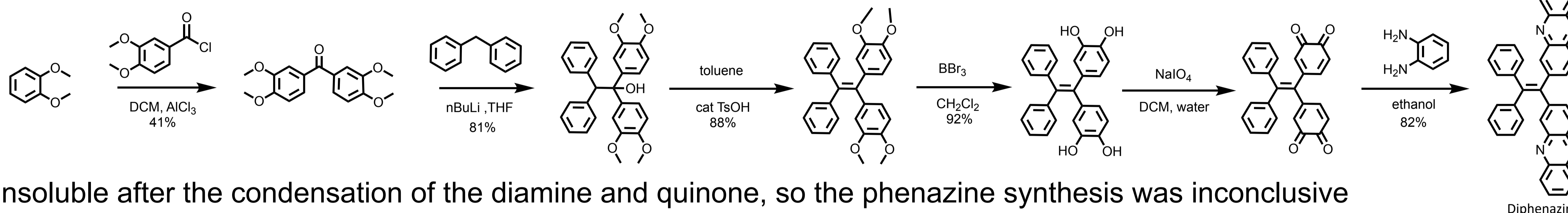


General Reaction Scheme



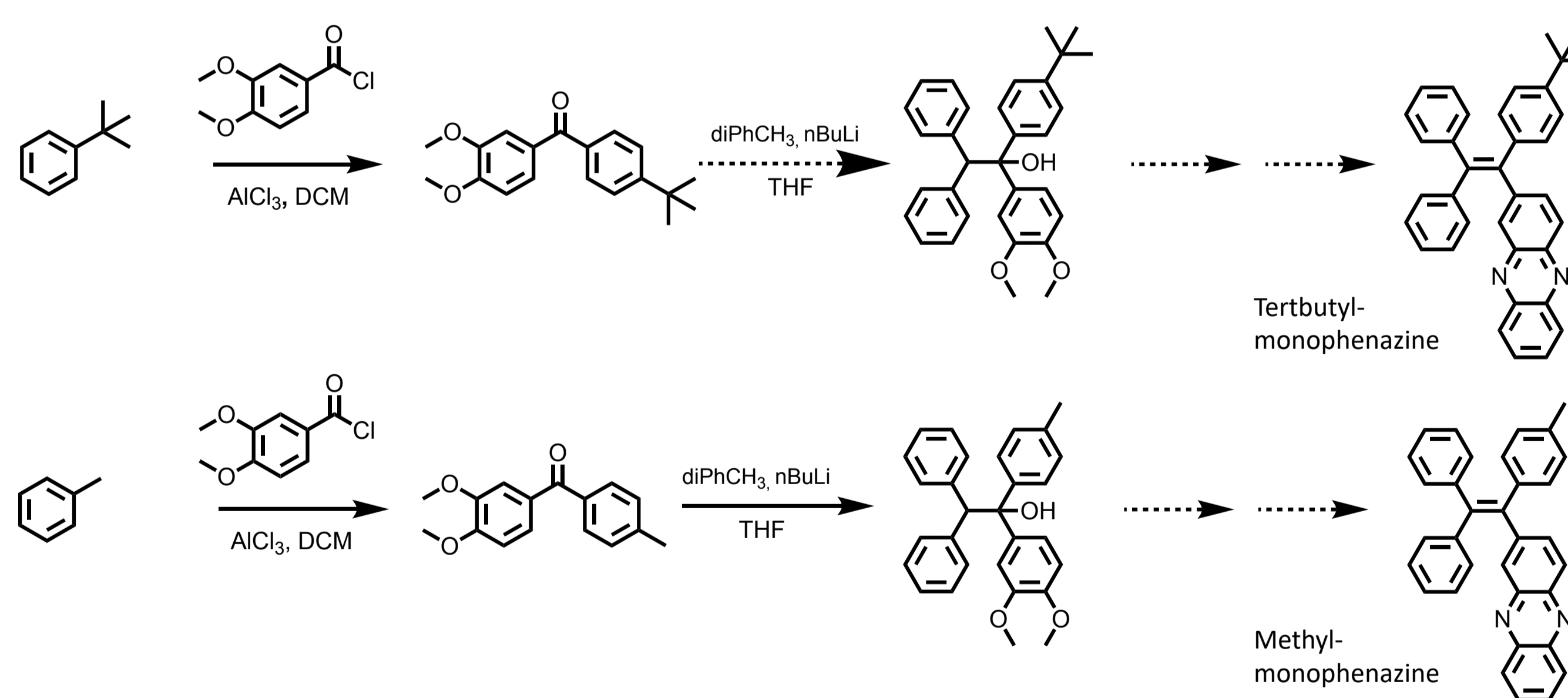
Phenazine TPEs are distinctly valuable derivatives because of their modular synthesis from quinones and diamines

Diquinone TPE Synthesis



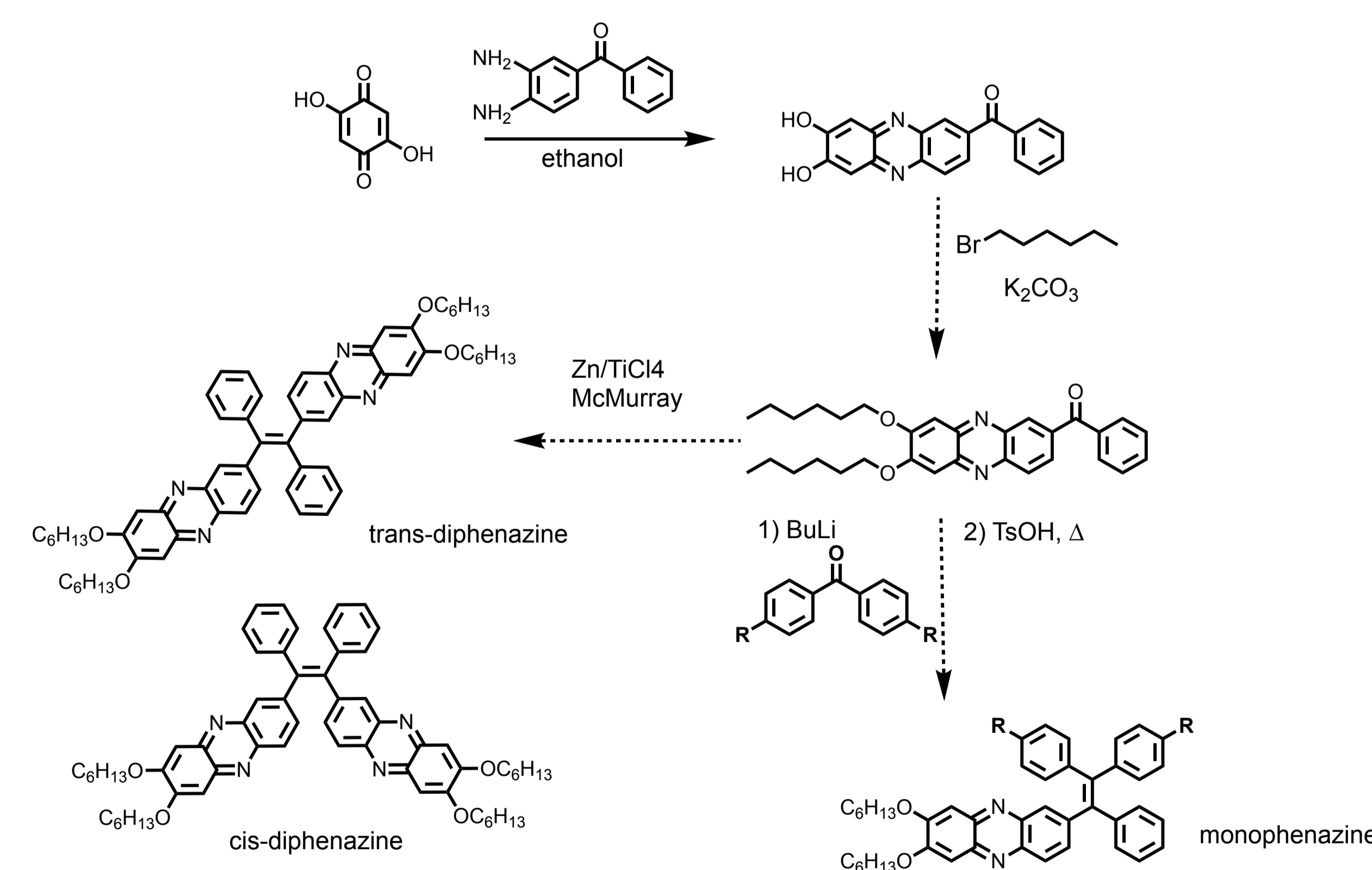
Insoluble after the condensation of the diamine and quinone, so the phenazine synthesis was inconclusive

Monoquinone TPE Synthesis



Using a similar synthetic route, we began the synthesis of monoquinones with R groups (methyl and tert-butyl) in hopes of synthesizing a more soluble phenazine TPE derivative

Alternate Phenazine TPE Synthesis



References

- (1) Mei, J.; Leung, N. L. C.; Kwok, R. T. K.; Lam, J. W. Y.; Tang, B. Z. Aggregation-Induced Emission: Together We Shine, United We Soar! *Chem. Rev.* **2015**, *115* (21), 11718–11940.
- (2) Mei, J.; Hong, Y.; Lam, J. W. Y.; Qin, A.; Tang, Y.; Tang, B. Z. Aggregation-Induced Emission: The Whole Is More Brilliant than the Parts. *Adv. Mater.* **2014**, *26* (31), 5429–5479.
- (3) Williams, A. R.; Northrop, B. H.; Chang, T.; Stoddart, J. F.; White, A. J. P.; Williams, D. J. Suitanes. *Angew. Chem. Int. Ed Engl.* **2006**, *45* (40), 6665–6669.

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Future Work

Complete synthesis of soluble mono and diphenazine TPE derivatives

Explore properties by fine tuning substituents

