

A Glowing Legacy: How Quinine Inspires Single-Chromophore Emitters with Delayed Emission

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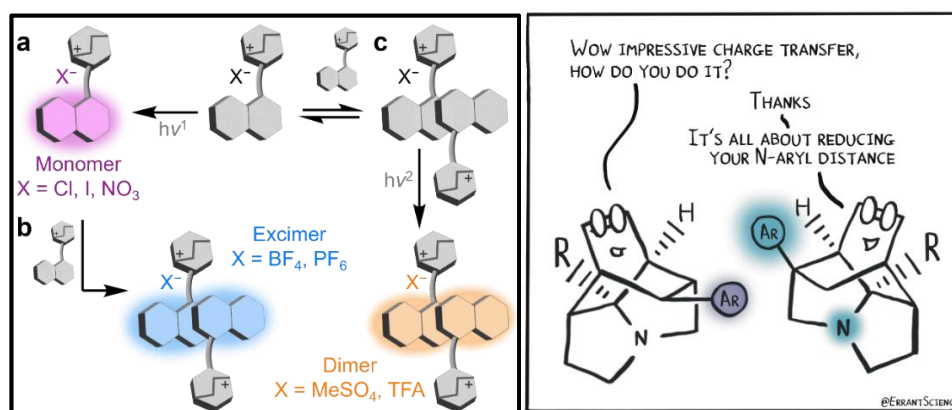
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Quinine, an essential antimalarial medicine and key ingredient of tonic water, has a glowing history in fluorescence spectroscopy. But can this historic compound inspire new breakthroughs in organic light-emitting materials? Specifically, can it help us understand and control thermally activated delayed fluorescence (TADF), a phenomenon that dramatically enhances organic light-emitting diode (OLED) efficiency and enables new sensing technologies?

The key to TADF is charge transfer, and quinine offers unique insights into how we can control this process at the molecular level. Unlike traditional donor-acceptor systems that require two different molecular components, quinine-based systems can achieve similar effects within a single chromophore, thus simplifying design and reducing energy loss pathways.

In this seminar, I will present three interconnected research threads from my group exploring the photophysical properties of quinine and its analogues. First, we investigate how different counterions in quinine salts influence the formation of excimers and dimers at high concentrations and reveal fundamental principles about molecular aggregation and emission. Second, we examine just how 'close' molecular fragments need to be to activate through-space charge transfer (TSCT) in quinine analogues, and how we can tune this interaction to generate delayed emission from single-chromophore systems. Finally, we explore whether these advantageous properties can be retained when we move beyond the quinoline scaffold entirely, opening pathways to new emitter designs.

This single-chromophore approach offers a significant advantage: with only one triplet state to manage, we can achieve better control over energy loss mechanisms, which is a critical step toward more efficient light-emitting materials and more sensitive molecular probes.



Related literature:

- [1] A. T. Turley, A. Danos, A. Prlj, A. P. Monkman, B. F. E. Curchod, P. R. McGonigal and M. K. Etherington, *Chem. Sci.*, 2020, **11**, 6990-6995.
- [2] A. Klimash, A. Prlj, D. S. Yufit, A. Mallick, B. F. Curchod, P. R. McGonigal, P. J. Skabara and M. K. Etherington, *J. Mater. Chem. C*, 2022, **10**, 9484-9491.
- [3] J. O. Watson, R. M. Pollard, M. T. Sims, M. K. Etherington and J. P. Knowles, *J. Phys. Chem. B*, 2024, **128**, 11208-11215
- [4] A. G. Carter, P. K. Saha, J. A. Aguilar, A. P. Monkman, A.-J. Avestro, M. K. Etherington and P. R. McGonigal, Under Review.

Biography:



Dr Marc Etherington is an Assistant Professor at Northumbria University, where he leads research on thermally activated delayed fluorescence (TADF) and charge-transfer processes in organic semiconductors. He holds a visiting position at Durham University and maintains active international collaborations.

Marc studied Physics at Durham University before completing his PhD at the University of Cambridge in 2015 under Prof. Neil Greenham. As a postdoctoral researcher with Prof. Andy Monkman at Durham University (2015-2020), he worked on two EU-funded projects developing TADF materials for organic light-emitting diodes (OLEDs). Since establishing his independent research group at Northumbria University in 2020 as a Vice-Chancellor's Senior Fellow, Marc has secured over £200,000 in research funding as PI, including a Royal Society ISPF International Collaborations Award. His group now focuses on photophysical characterization and molecular design for applications spanning OLEDs to bioimaging, supervising multiple PhD students working across synthesis and spectroscopy.