

Sustainable synthetic methods for the production of peryleneimonoimide derivatives and their application in retinal photosensitisation

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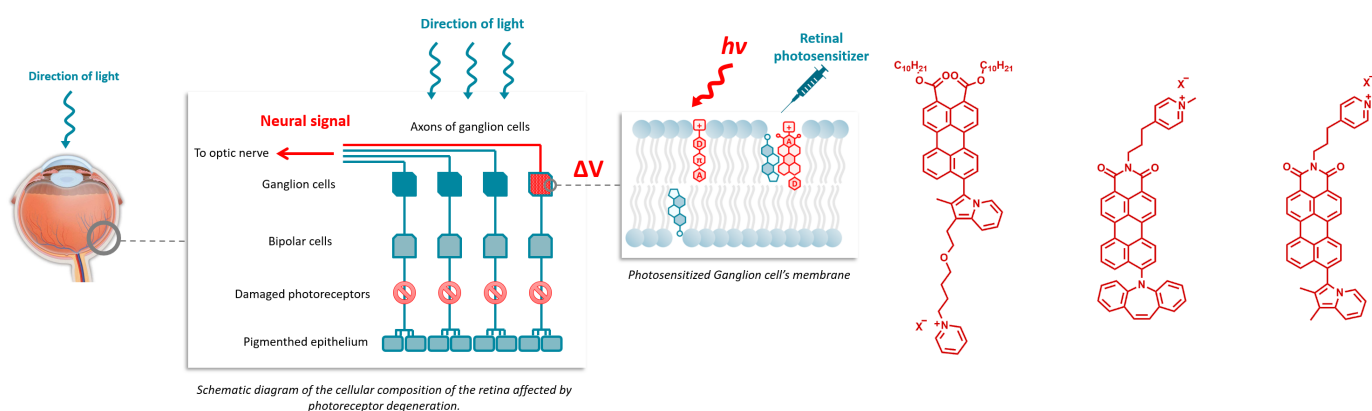
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Perylene Monoimide (PMI) dyes have catalysed a growing interest in a wide range of applications, from dyes to organic solar cells and bioimaging, thanks to a unique combination of properties: they exhibit exceptional photostability, thermostability and chemostability, along with valuable spectroscopic properties such as high Stokes shift, excellent quantum yields, high molar absorptivity. In addition, functionalization enables further tailoring of properties according to the target application. The key intermediate for obtaining asymmetric PMI is perylene monoanhydride (PMA). Current synthetic processes involve numerous inefficient steps, harsh conditions and the use of toxic solvents, as well as solvent intensive purification, due to the poor solubility of the species [1]. To address these challenges, we have developed and scaled up an efficient synthetic protocol for PMA synthesis, featuring environmentally friendly solvents (such as water), mild reaction conditions, high yields and easy post-processing. Exploiting the synthetic versatility of the PMA core, a library of amphiphilic push-pull probes, capable of intercalating in cell membranes, anchoring to anionic phosphate groups via pyridinium anchoring moiety, was designed.

Rylenic cores are suitable candidates as fluorescent membrane probes due to their outstanding biocompatibility and broad Stokes shift and given their planarity and lipophilicity, are optimal for intercalating into phospholipid bilayer. Relevant applications include use as packing [2] or polarity probes in cell membranes in combination with FLIM (Fluorescence Lifetime Imaging) [3].

This architecture can originate VIS-photoinduced twisted intermolecular charge-transfer states in which planarization of the molecule occurs, such spatial reorganization of the probe could lead to local changes in membrane thickness, sufficient to generate an overall change in membrane potential, similar to what has been observed in the case of azobenzene photoactuators [4]. They potentially transduce the VIS light into a membrane potential difference to trigger a neural response restoring the electrophysiological responses of the blind retina, affected by macular degeneration or retinitis pigmentosa. These species are currently being tested in vitro at IIT as retinal photosensitisers.



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