Exciting New Red Fluorescent Dyes

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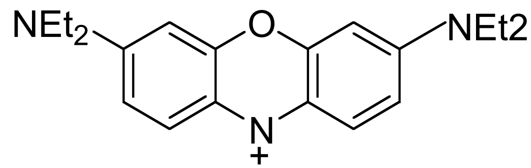

Oxazine 1. Counterion not shown.

Fluorescent dyes are molecules that absorb light of one wavelength and emit at a different (longer) wavelength. Biologists frequently attach fluorescent dyes to biological molecules to observe cellular-level behavior against a dark background. Since hemoglobin and melanin absorb blue and green light, dyes which absorb red light and emit in the red or near-infrared (NIR) spectral region are preferable for biological applications involving living tissues. However, red dyes in general have low fluorescence quantum yields, a measure of the number of photons emitted per photons absorbed by the dye, which limits the intensity of the fluorescent signal that can be detected. Heat generation, called internal conversion, competes with fluorescence, and therefore is an undesirable characteristic in a luminescent material. The goal of our research project was the discovery of mechanisms that cause internal conversion. Using a rational approach, we altered the basic structure of the known dye Oxazine-1, a red fluorescent dye, in ways that reduced internal conversion and as a consequence increased fluorescence. The attachment of a series of geometrically constrained electron donor groups to the dye improved both the quantum yields and the fluorescent lifetimes, the amount of time after photon absorption that the molecule emits a photon. Additionally, empirical observation showed these new oxazine dyes were more photostable than similar commercially available materials. The outcome of this research suggests further possibilities for designing improved red fluorescent dyes that may be useful in biological research.

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