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Photostability of push-pull phenanthroimidazole derivative upon one- and two-photon excitation

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Streszczenie

A phenanthroimidazole derivative with N,N-dimethylamino substituent was synthesized and tested to unravel the relationship between the photophysical properties and its structure. The positions of absorption and emission maxima of the dye vary with increasing solvent polarity and exhibit positive solvatochromism. The fluorescence quantum yields of the dye are moderate and range from 3% to 20% depending on the environment, the higher values being observed in less polar solvents. Two lifetimes were detected based on the fluorescence decay curves, the short lifetime was assigned to the emission from a non-relaxed excited state whereas the long lived time indicated emission from a solvent relaxed excited state. The linear correlations between fluorescence maxima, Stokes shift, fluorescence quantum yield and f(ε,n) confirm the importance of the solvent polarity function, f(ε,n), in the energetic stabilization of the dye in the S_1 excited states. The prototropic study indicates that 1 forms a monocation upon protonation at phenanthroimidazole nitrogen in low acidic acetonitrile and a dication at lower pH. The second protonation occurs at dimethylamino nitrogen and causes a hypsochromic shift as the lone pair of electrons on this nitrogen no longer participates in conjugation. The tested compound reveals poor photostability in solution. The trans-cis photoisomerisation of the compound has been studied by UV–Vis and ^{1}H NMR spectroscopy, with either visible or near-infrared irradiation of the sample. One and two-photon irradiation of the dye leads to the similar effect: photoisomerization under short time irradiation and degradation upon longer exposure of the sample to light.

Słowa kluczowe

Phenanthroimidazole, Synthesis, Spectroscopic properties,
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