

BEAM Conference 2025

19–21 March 2025 | Halle (Saale), Germany

Evaluation of the Polymeric Chain Length Effect on The Solvatochromic Behavior of ESIPT Dyes

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Excited-State Intramolecular Proton Transfer (ESIPT) dyes have gathered significant interest due to their unique four-level fluorescence mechanism. This process, driven by tautomerism in the excited state, confers distinctive photophysical properties, including large Stokes shifts, high photostability and sensitivity to environmental changes. Variations in the solvation environment can alter the ratios between the enol (E*) and keto (K*) excited-state tautomers, thereby modulating dual fluorescence emission. These characteristics render ESIPT dyes highly versatile for applications spanning bioimaging to optoelectronics. However, the inherent hydrophobicity of ESIPT dyes often limits their utility in aqueous systems, where aggregation can occur. Additionally, the intramolecular proton transfer in polar protic solvents is hindered due to solvation effects and dominant intermolecular interactions. To address these challenges, this study explores the development of amphiphilic derivatives of 2-(2-hydroxyphenyl)benzoxazole to enhance the compatibility of ESIPT dyes in aqueous environments. Given their sensitivity to the microenvironment, derivatives with varying chain lengths were synthesized and evaluated. Herein, we present preliminary findings that demonstrate their synthetic accessibility and fluorescence behavior in both organic and aqueous media. Using steady-state fluorescence spectroscopy we investigated the influence of chain length on the solvatochromic properties and aggregation tendencies of the ESIPT dyes. Furthermore, the impact of varying water concentrations on fluorescence emission was examined to elucidate the driving forces leading to preferable intra- or intermolecular interactions. Understanding the photophysical behavior of amphiphilic ESIPT dyes in aqueous systems provides a promising pathway for extending their applicability to highly polar environments, thereby advancing their potential in supramolecular chemistry and biomedical material design.