Energy Downshifting of Amplified Spontaneous Emission via Strategic Modification to Excited-State Proton Transfer Mechanism

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Achieving color tunability through chemical structural modification has been a significant advantage of organic solid-state laser dyes (OSSLs) over their inorganic counterparts. However, red-shifting the emission spectrum to longer wavelengths often compromises their photophysical properties and amplified spontaneous emission (ASE) thresholds, mainly arisen from their undesired high non-radiative rates.1 In this talk, the development of new 2-hydroxyphenylbenzothiazole (HBT)-based organic laser dyes will be presented to show extremely large Stokes shifts (up to 236 nm) and low ASE thresholds (5.3 µJ/cm²) with the emission being shifted to longer wavelengths (to give an ASE peak at 609 nm).2 Excellent photostability of the new laser dye films will be shown under both vacuum and ambient conditions. Density functional theory (DFT) and time-dependent DFT will be discussed to reveal the reason for extremely large Stokes shifts, which contrasts with the standard π-delocalized tautomerism seen in its derivatives, an example of the most efficient ESIPT resulted from a different excited-stated-proton transfer mechanism3,4 that likely contributed to its superior ASE photostability.

References