Advanced organic laser materials and devices

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Abstract

The development of novel materials for advanced photonic applications, such as luminescence, lasing, light harmonics generation, and all-optical switching, remains a significant challenge. This work investigates organic materials designed for tunable lasing and efficient light amplification, focusing on the interplay between molecular structure and device performance.

We synthesized novel pyrazoline and thiophene derivatives as representative push-pull chromophores, exploring their potential for light amplification via amplified spontaneous emission, random lasing, and distributed feedback lasing.

Also Excited-State Intramolecular Proton Transfer (ESIPT) compounds, have attracted our considerable attention, due to their unique optical properties. In this contribution we show a novel bis-trimethylsilyl substituted 2-(2'hydroxyphenyl)benzothiazole (HBT) derivatives functionalized with a trifluoromethyl - a strong electron-withdrawing group. Such structure enabled real-time red-green-blue (RGB) switching of emission, both in solution and solid-state, providing white laser light emission.

The influence of chemical structure on lasing efficiency was systematically investigated.

These chromophores were incorporated into various systems, including those based on polymer matrices and multifunctional phase-separation systems incorporating liquid crystals and ionic liquids. Precise color tuning was achieved by manipulating external electric DC fields or pumping energy density. Our findings demonstrate the strong relationship between molecular structure, nonlinear optical properties and lasing performance. The ability to precisely control the light amplification by adjusting molecular structure and incorporating the chromophores into diverse environments offers a route to developing compact, highly tunable, and efficient organic laser sources for various applications. These results are a step toward advanced photonic devices with improved performance and functionality.

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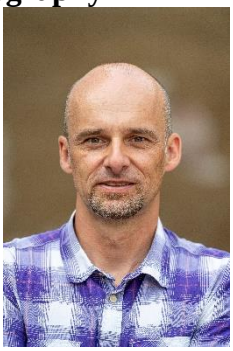
Biography



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