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Novel highly luminescent diketofurofuran dye in liquid crystal matrices for thermal sensors and light amplification

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Streszczenie

Research is underway to find organic dyes with high photoluminescence quantum yield (QY) and having compatibility with liquid crystals (LCs) that would be suitable for application in LC systems such as light sources, light converters and sensors. An attempt was made to obtain a highly efficient photoluminescent compound in a class of diketofurofuran (DFF) dyes. The new DFF dye has been synthesized and compared with an analogous diketopyrrolopyrrole (DPP) one with LC properties. The synthesis, crystal structure, and thermal and luminescent properties of the DFF dye as well as characterization of the compound incorporated in liquid crystalline thermofluorochromic and light amplification systems are reported for the first time. It was found that the QY of the studied DFF strongly depends on the matrices in which it was dispersed, reaching a value equal to or greater than 95% in liquid and LC matrices, which is reported for the first time in a DFF class of dyes. Switching of luminescence efficiency by temperature was performed for selected dye-doped thermotropic LC systems. A significant and reversible change of emission intensity and colour upon melting/crystallization below 100 °C was observed. DFF and DPP dyes incorporated into a selected thermotropic LC host were compared with five commercial laser dyes in terms of their performance as thermofluorochromic indicators. Very high contrast between the emission efficiency in nematic and crystal phases and relatively high change of the emission colour make the DFF dye under study one of the best among the studied dyes. This change was attributed to the emerging red-shifted absorption band in the crystalline state and a low Stokes shift. The difference in solubility of the studied DFF and *N*-methyl substituted DPP dyes, tested in two nematic LC hosts, was attributed to the higher tendency for self-aggregation of the DFF molecules. An Amplified Spontaneous Emission (ASE) signal in cholesteric LC cells with a comparable threshold was found for the studied DFF and DPP dyes.

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