

Design and synthesis of chiral pyrene dimers for enhanced circularly polarized luminescence

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Circularly Polarized Luminescence (CPL) emitting organic molecules are intensively researched for their promising prospects on the application in 3D display devices, biomedical imaging, and information technology. In recent years researchers are actively taking interest in the CPL from excimer state molecules. In the work published in 1985, pyrene excimer was recognized as a CPL emitting chromophore. Compared to other CPL emitting organic molecules reported until today, the dissymmetry factor, g_{lum} for pyrene excimer was considerably high, around 0.012¹, where dissymmetry factor g_{lum} is defined as $\frac{2(I_L - I_R)}{(I_L + I_R)}$ and can have the value between $-2 \leq g_{lum} \leq +2$.

In this research we designed and synthesized chiral pyrene dimers, (1) bridged by three atoms with single sulfur atom, and (2) bridged by two carbon atoms, to understand if the design of excimer state molecules can be one of the methods to exemplify the CPL performance in organic molecules. The synthesized enantiomers were separated using chiral HPLC and are shown by the CD spectrum in Fig 3. The g_{lum} for (1) is approximately 0.03, which is considerably larger than CPL measured from common organic molecules. But due to the poor stability of the compound, we designed and synthesized the carbon bridged pyrene dimer (2). The FL spectra of the two pyrene dimers are shown in Fig 4. For structure (1), a new emission band at 550 nm was observed, which would be originated from the excimer state of the sulfur bridged dimer. For (2), an unexpected blue shift in the FL with emission measured at 450 nm was observed. The CPL measurement of (2) is now ongoing. The UV and CPL spectroscopic data for the designed structures will be further discussed in the presentation.

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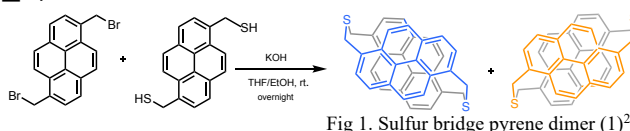


Fig 1. Sulfur bridge pyrene dimer (1)²

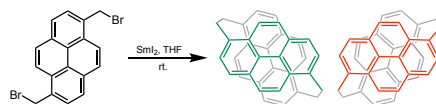


Fig 2. Carbon bridge pyrene dimer (2)³

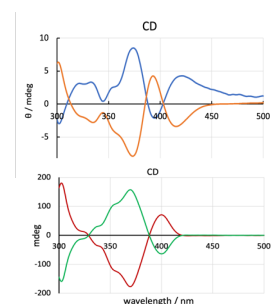


Fig 3. CD for (1) -top, and (2) -bottom

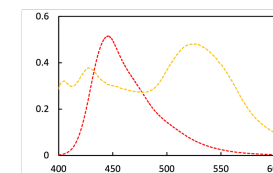


Fig 4. FL of (1) -(540 nm) and (2) -(450 nm)