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Article

Multifunctional Fluorescent Tetraphenylethene-Based Reversible Mechanochromism for Highly Selective Detection of MnO_4^- in Aqueous Media and Green Organic Light Emitting Diode Applications

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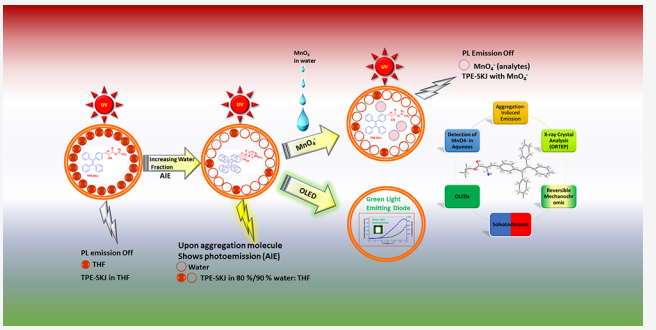
ABSTRACT: Ethyl 2-cyano-3-(4-(1,2,2-triphenylvinyl) phenyl) acrylate (TPE-SKJ), a newly synthesized luminogen based on tetraphenylethene, with single crystal analysis exhibits photophysical phenomena such as aggregation-induced emission (AIE); reversible mechanochromic, solvatochromic, organic light emitting diode; and chemical sensing in aqueous media with great selectivity and a low limit of detection. The synthesized material demonstrates high selectivity and sensitivity capacity for sensing MnO_4^- in mixed aqueous media (water/acetonitrile, v/v, 9/1). The detection limit for MnO_4^- was found to be 0.086009 μg mL^{-1} with a quantum yield (Φ) of 11%. Moreover, we employed TPE-SKJ material in an organic light-emitting diode (OLED) as an emissive layer. The device shows a maximum of 1.62% external quantum efficiency, higher than nondoped emitting layer-based green OLEDs. The present results will encourage ongoing research into the design of novel stimuli-responsive organic materials with switchable properties based on their supramolecular interactions for numerous applications.



1. INTRODUCTION

Aggregation-induced emission (AIE), a type of photophysical phenomenon connected to the aggregation of the chromophore moiety, was first proposed by Prof. B. Z. Tang and his team in 2001. In an aggregation-induced emission (AIE) mechanism, the water content in the mixture affects how quickly weak or nonemissive luminogens aggregate to become emissive; it means aggregation-induced emission means weak or nonemissive luminogens become emissive upon aggregation. Early research on AIE indicated that scientists were more interested in how a substance's molecular structure might affect it. As time went on, it was discovered that not all emission phenomena, particularly polymorphisms with various emissive features, could be described by molecular structure. In contrast, AIE exhibited a normal solid-state luminescence behavior, and the change in molecular packing from intense $\pi-\pi$ stacking to a suppressed one was the primary cause of the transition from ACQ to AIE. As a result, researchers started to concentrate more on molecule packing than molecular structure.[1−3] The tetraphenylethene-based luminogens show amazing photophysical phenomena such as aggregation-induced emission, solvatochromism, reversible mechanochromic, etc., which have very useful applications in diverse fields.[4]

Because of their use in optical information storage camouflage, mechanical sensors, memory chips, and security papers, luminogens with reversible stimulus-responsive switching in the solid state have drawn a great deal of attention.[5−8] Industry and academia have recently become enthusiastic about the successful applications of various aggregation-induced emission (AIE)-based reversible mechanochromic (MC) materials in cutting-edge nanotechnologies.[9−11] Contrary to conventional fluorophores, AIEgens have had the unique property of an emission strongly in the aggregated state (solid) despite being nonemissive in the solution state, due to restrictions on intramolecular rotations (RIR) or restrictions

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