ChemistrySelect

Research Article
doi.org/10.1002/slct.202203185

Chemistry Europe
European Chemical Societies Publishing

www.chemistryselect.org

A Tetraphenylethene-Based Aggregation-Induced Emission Luminogen (AIEgen) With Mechanochromic Phenomena for Highly Selective Naked-Eye Detection of MnO_4^- Directly in Aqueous Media

Kishor S. Jagadhane,[a, c] Sneha R. Bhosale,[a] Alfredi A. Moyo,[a] Govind B. Kolekar,[b] Kirankumar K. Sharma,[c] Hemraj M. Yadav,[c] and Prashant V. Anbhule*[a]

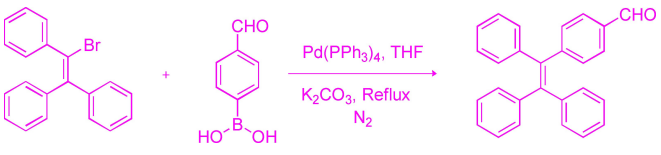
It is challenging to work on the detection of toxic anions and pollutants directly from aqueous media by using organic molecules. The ability to detect MnO_4^- selectively and sensitively is essential to improving human health and protecting the environment. As a result, a Tetraphenylethylene-based chemosensor was successfully synthesized and fully characterized with modern spectroscopic techniques and applied as a new rapid naked-eye detection for the MnO_4^- in a mixed aqueous media ACN: H_2O (v/v = 1/9) by significantly switching off an emission in a mixed aqueous media over another anion. Chemosensor has been thoroughly studied, which shows remarkable photophysical properties such as aggregation-induced emission (AIE) and mechanochromic phenomena. The linear regression (R^2) is ≈ 0.98 μgmL^{-1} and the LOD (the detection limit) as low as 0.150418 μgmL^{-1} is possible for MnO_4^-. This work demonstrates structure-property and application relationships of TPEgen scaffolds and connects topics such as AIE, mechanochromic phenomenon, and naked-eye fluorescence sensing. The current study's fundamental knowledge helps improvement in the fields of TPEgen, anion coordination triggered emission and naked eye fluorescence sensing. As a result, a chemosensor can be developed into a prospective luminescent sensor for detecting MnO_4^-, as well as onsite detection by using the paper-based sensor.

Introduction

Nowadays, tetraphenylethylene-based luminogens (TPEgen) have become very popular for detecting anions from biological and environmental sources because of their interesting photophysical phenomena, such as aggregation-induced emission and the mechanochromic phenomenon, for their high selectivity, sensitivity, and ease of evaluation.[1–4] Tetraphenylethene is one of the common building blocks that are responsible for such interesting photophysical phenomena as aggregation-induced emission and mechanochromic properties. The reported chemosensor (TPEgen) exhibited aggregation-induced emission with the illumination of a UV lamp (365 nm). The diluted solution of chemosensor in acetonitrile emits a modest while its solid state emits a strong yellowish color.[5,6]

Due to the hydrophobic nature of a chemosensor, it is universally acknowledged that the aggregation-induced emission of active sensors developed from tetraphenylethene.[7,8] It is very famous for having a propeller structural characteristic that is π-π stacking in aggregates and solids are avoided for aggregation-induced emission luminogens. TPEgens have long been recognized to be AIE-active because of the hydrophobic nature of tetraphenylethene.[8] Also, tetraphenylethene has a propeller-shaped structure with rotating aromatic phenyl rings on the periphery. In the research of recent years, it has been discovered and proved that when in dilute solutions the free rotation of the peripheral aromatic ring is allowed and there is nonradiative decay induced from the excited state.[9–11] TPEgens possess "aggregation-induced emission," for which the tetraphenylethene-based luminogens are mostly used to explain the complexation with the ions. For the detection of anions with chemosensors, the functionalization of TPEgens molecular architecture has overhanging coordinating sites, which is the better way to synthesize for the same.[8]

Recently, aggregation-induced emission and mechanochromic luminogens have been successful in detecting anions and harmful pollutants in aqueous media. So, the reported chemosensor having hydrazine carbothioamide sparked a lot of



Scheme 1. Synthetic route to TPE-CHO 4-(1, 2, 2-triphenylvinyl) benzaldehyde.

[a] *K. S. Jagadhane, S. R. Bhosale, A. A. Moyo, P. V. Anbhule*
Medicinal Chemistry Research Laboratory, Department of Chemistry, Shivaji University, Kolhapur, Maharashtra, 416004, India
E-mail: pva_chem@unishivaji.ac.in
[b] *G. B. Kolekar*
Fluorescence Spectroscopy Research Laboratory, Department of Chemistry, Shivaji University, Kolhapur, Maharashtra, 416004, India
[c] *K. S. Jagadhane, K. K. Sharma, H. M. Yadav*
School of Nanoscience and Biotechnology, Shivaji University, Kolhapur, Maharashtra, 416004, India

Supporting information for this article is available on the WWW under https://doi.org/10.1002/slct.202203185