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A Novel pH Probe Based on Ratiometric Fluorescent Properties of Dicyanomethylene-4*H*-chromene platform

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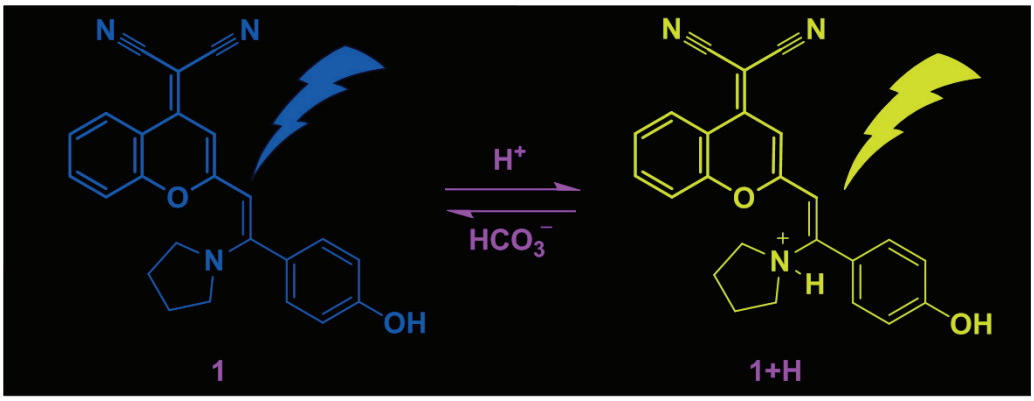
Abstract

We report here a ratiometric pH probe (Z)-2-(2-(2-(4-hydroxyphenyl)-2-(pyrrolidin-1-yl)vinyl) -4H-chromen-4-ylidene)-malononitrile over the pH range of 2.44 - 6.00. It was synthesized by Knoevenagel Reaction from dicyanomethylene-4H-chromene and pyrrolidine. This is the first example of pyrrolidine as a part of the product structure in Knoevenagel condensation. High selectivity and sensitivity for pH variation were observed with significant fluorescent ratiometric responses and a remarkable Stokes shift (about 138nm). The probe was stable in the studied solvent and no obvious fluorescence changes were detected in acidic media within one month at room temperature.

Graphical abstract



Keywords: ratiometric probe, pH, dicyanomethylene-4*H*-chromene, remarkable Stokes shift, reusable

1. Introduction

pH parameter plays a key role in the fields of chemical reactions and many physiological processes. The measurement of the pH value is extremely important to understand the regulation mechanism [1-2]. Compared with the traditional methods, fluorescent probes for pH detection were drawn more and more attentions because of their rapid response, high signal-to-noise ratio, noninvasiveness, and excellent pH sensitivity [3-4]. So far, a large number of specific and highly sensitive fluorescent probes for pH detection were developed based on fluoresceins, coumarines or rhodamines. However, most of them were focused on the pH range from 4 to 8 due to their unstability or the cell inactivation under extreme pH [5-9]. Due to the lack of fluorescent probes suitable for the detection of pH below 4 [10-17], there is a great demand to develop small molecular fluorescent probes for monitoring harsh pH media in the area of environmental and biological science. Dicyanomethylene-4H-chromene-based (DCM-based) conjugated system serves as a useful fluorescent platform owing to its near-infrared characteristics and photostability.