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Review

Small-molecule fluorescent probes for the detection of carbon dioxide

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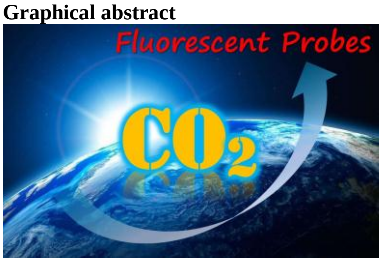
Graphical abstract



This review summarizes the design principles, recognition mechanisms, properties and functions of various kinds of small-molecule fluorescent probes for the detection of carbon dioxide.

ABSTRACT
During the last few years, the preparation of novel fluorescent probes for the detection of carbon dioxide has attracted considerable attention since carbon dioxide plays extremely important roles in widespread fields including chemical, environmental, clinical analysis, and agri-food industry. This review focuses on the recent advances in the design principles, recognition mechanisms, and preparation of small-molecule fluorescent probes for the selective detection and monitoring of CO_2. Moreover, their properties and functions will be discussed detailedly as well

Keywords:
Fluorescent probe
Carbon dioxide
Design principle
Sensing mechanism

1. Introduction

Carbon dioxide (CO_2) is one of the catabolic end products of cellular respiration in organisms that gain energy by decomposing sugars, fats and amino acids with oxygen [1]. Moreover, as a very common component of gas mixtures from several natural and anthropogenic processes including the combustion of fossil fuels for power generation, natural gas production, oil refining, and most chemical manufacturing, carbon dioxide has significant impacts on globe climate and human wellbeing such as the greenhouse effect, rise in sea levels, and probable expansion of subtropical deserts as well [2−8]. Recent research suggests that the carbon dioxide concentrations in cells are closely related to multiple physiological and biological processes such as respiratory regulation, pH equilibrium in the blood, carcinogenesis, genetic material replication, nucleic acid base formation, and cell proliferation [9]. Therefore, the development of highly efficient methods for the detection and monitoring of CO_2 is extremely important in widespread fields such as chemical, environmental monitoring, clinical analysis, and agri-food industry [10,11].

Many approaches, such as infrared spectroscopic technique, electrochemical assay, gas chromatography-mass spectrometry (GC-MS) technique, field-effect transistors have been employed to measure and monitor CO_2 [12−14]. However, these methods often suffered from high cost, time-consuming processes, and lack of temporal and spatial resolution. Due to its simple, inexpensive, rapid sensing, and real-time detection abilities, fluorescence technique has proven to be one of the most efficient approaches for the detection of CO_2 [15−23].