Sensors & Actuators: B. Chemical 316 (2020) 128082

Contents lists available at ScienceDirect

Sensors and Actuators B: Chemical

journal homepage: www.elsevier.com/locate/snb

# Synthesis of new Schiff's base copper conjugate for optically and electrochemically tuning of L-cysteine in cancer cells and bovine serum albumin

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ARTICLE INFO

*Keywords:*
Biosensor
Reversible dual detection
Multi analytical techniques
Logic circuit
Live cell images

ABSTRACT

An environmentally benign chemosensor probe-N'1,N'4-bis((E)-2-hydroxy-3,5-diiodobenzylidene)terephthalohydrazide (HDT) is synthesized *via* Schiff base reaction between the terephthalic acid and dihalo-substituted salicylaldehyde. The turn-off-on fluorescence technique is accomplished for the detection of cysteine (Cys), in which the fluorescence behavior of HDT probe is initially quenched with $Cu^{2+}$ ions *via* the chelation effect by the formation of the HDT-$Cu^{2+}$ conjugate. The quenched fluorescence behavior of HDT in HDT-$Cu^{2+}$ conjugate is restored with Cys, owing to the formation of a stable Cys-$Cu^{2+}$ conjugate. Under optimized conditions, the as-developed HDT-$Cu^{2+}$ conjugate demonstrates the lower detection limit and broad linear range, respectively, of 55 nM and 0–200 μM on Cys sensing. It also accelerates the selective detection of Cys even under the existence of biologically relevant amino acids. The electrochemical detection of as-prepared HDT-$Cu^{2+}$ conjugate toward Cys is also enunciated from the cyclic voltammetry studies. Furthermore, the as-developed probes (HDT and HDT-$Cu^{2+}$) comprehend their practical sensing applicability toward $Cu^{2+}$ ions and Cys detection in cancer cells (A459 cancer cells), opening progressive research avenues towards the scale-up process of developed chemosensor probe in sensitive and selective Cys detection.

## 1. Introduction

Copper (Cu), an essential heavy transition metal governs a significant role in the regulation of various fundamental metabolic and physiological processes of human system including sufficient growth, neuroendocrine function, neovascularization, cardiovascular integrity, and lung elasticity [1,2]. According to World Health Organization (WHO), the permissible limit of Cu in drinking water is prescribed as 2 ppm and its approved concentration in human system is 10–22 μM [3,4]. The anomalous concentration of Cu in human system may lead to neutropenia, anemia, cardiac hypertrophy, bone fragility, impaired immune function and central nervous system, peripheral neuropathy *etc.*, [5]. Henceforth, the indispensable governance of Cu concentration in human system is critical, which would be accomplished with the consecutive and tight monitoring of Cu. In this line, various analytical techniques including atomic absorption spectrometry, inductively coupled plasma mass spectroscopy, and electrochemical method have been exploited for the detection of Cu ions [6]. However, the aforementioned techniques compelled the use of sophisticated and time consuming pre-treatment processes and trained expertise, which collectively enhances the analyses cost. It postulates the evolution of a simple, rapid, sensitive, and selective technique for the $Cu^{2+}$ ions detection. In this context, fluorescence and colorimetric chemosensors have been widely explored for $Cu^{2+}$ ions sensing as they possess distinct advantages like simplicity, cost-effective, facile structural adjustment and high sensitivity [7,8].

On the other side, cysteine (Cys) is deemed as the most abundant intracellular bio-thiols, possessing significant biochemical functions including protein synthesis, detoxification, metabolism, and metal binding [9,10]. Cys also serves as a potential neurotoxin and biomarker

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https://doi.org/10.1016/j.snb.2020.128082
Received 8 May 2019; Received in revised form 2 April 2020; Accepted 3 April 2020
Available online 18 April 2020
0925-4005/ 