A Multi-signal Fluorescent Probe with Multiple Binding Sites for Simultaneous Sensing of Cysteine, Homocysteine, and Glutathione

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Education:

- **1999–2003** B.S., Jilin University
- **2003–2006** M.S., Peking Union Medical College
- **2007–2012** Ph.D., Nanyang Technological University

Work Experience:

- **2006–2007** Shanghai Apptec Co., Ltd.
- **2012–2018** lecturer, College of Chemistry and Chemical Engineering, Hunan Normal University
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Scheme 1. Simultaneous sensing of Cys, Hcy, and GSH based on the four binding sites of probe BCC.

Scheme S1. The structure of cysteine (Cys), homocysteine (Hcy) and glutathione (GSH).
硫醇荧光探针的发展历程

探针发现

1966—1981年

**Anal. Biochem., 1966, 14, 434.**

探针拓展

1981—2009年


探针活跃

2009—2012年


2012—2016年


2016年—至今

存在的问题:

- 静态的生物标记
- 三种生物硫醇相互干扰

Introduction

Figure 1. Time-dependent absorption spectra of BCC (10 mm) in the presence of 10 equiv of Cys (a), Hcys (b), GSHs (c), and NACs (d) in DMSO/PBS (pH 7.4, 10 mm, v/v, 6/4) at RT. DMSO= dimethyl sulfoxide, PBS= phosphate-buffered saline.
Figure 2. a,c,e) Time-dependent fluorescence spectra of BCC (10 mm) in the presence of 10 equiv of Cys excited at 360 nm (a), 10 equiv of Hcy excited at 480 nm (c), 10 equiv of GSH excited at 400 nm (e). b,d,f) Time-dependent fluorescence intensity changes toward 10 equiv of biothiols excited at 360 nm (b), 480 nm (d), and 400 nm (f). Condition: DMSO/PBS (pH 7.4, 10 mm, v/v, 6/4) at room temperature. Slit (nm): 2.5/2.5.

Blue: 455 nm-490 nm;  
Yellow-Green: 560nm-580nm;  
Blue-Green: 515nm-540nm
Scheme 2. Proposed reaction mechanisms of probe BCC with Cys, Hcy, and GSH.
**Introduction**

**Figure 3.** Confocal fluorescence images of Cys, GSH, and Hcy in BEL-7402 cells. A1–A3) Cells were incubated for 30 min, then imaged. B1–B3) Cells were incubated with probe BCC (2.5 mm) for 30 min, then imaged. C1–C3) Cells were pretreated with NEM (0.5 mm, 30 min), subsequently incubated with Cys/GSH/Hcy (500 mm, 30 min) and probe BCC (2.5 mm, 30 min), then imaged ($\lambda_{\text{ex}}=405$ nm, $\lambda_{\text{em}}=421–475$ nm for the blue channel; $\lambda_{\text{ex}}=458$ nm, $\lambda_{\text{em}}=500–550$ nm for the green channel; and $\lambda_{\text{ex}}=543$ nm, $\lambda_{\text{em}}=552–617$ nm for the red channel). Scale bar: 20 mm.

BEL-7402 Cell: 人肝癌细胞
Result and Discussion

They designed and synthesized a novel chlorinated coumarin-benzothiazolium fluorescent probe (BCC) with four binding sites, which can simultaneously and selectively detect Cys, Hcy, and GSH in three different emission channels.

Highlight:

1. Simultaneous distinguishing detection of Cys, Hcy and GSH for the first time.

2. probe BCC can be used to simultaneously monitor endogenous Cys and GSH and exogeneous Cys, Hcy, and GSH through multicolor imaging.