

A New Rhodamine-Based Colorimetric Cyanide Chemosensor: Convenient Detecting Procedure and High Sensitivity and Selectivity

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ABSTRACT By applying an indirect strategy, a new rhodamine-based dye (**I**) was successfully developed as a colorimetric chemosensor for the sensitive detection of cyanide. In the presence of copper ions, the colorless solution of compound **I** changed to magenta; however, upon the addition of trace cyanide, the magenta color faded to colorless immediately, with a detection limit as low as 0.013 ppm ($\Delta A = 0.054$), much lower than the Maximum Contaminant Level for cyanide in drinking water (0.20 ppm) set by the US Environmental Protection Agency. Other anions, including Cl^- , I^- , IO_3^- , SO_4^{2-} , NO_2^- , Br^- , H_2PO_4^- , F^- , SCN^- , HSO_4^- , and ClO_4^- , had nearly no influence on the probing behavior of dye **I** toward cyanide.

KEYWORDS: colorimetric chemosensor • cyanide • indirect method • rhodamine-based dye • high sensitivity • visual detection

INTRODUCTION

Considerable attention has been paid to the development of new cyanide chemosensors that are easy to handle in addition to having high sensitivity and selectivity, because of the high toxicity of cyanide to living creatures and the wide applications of cyanide and hydrogen cyanide in different fields, such as industrially in gold mining, electroplating, metallurgy, and the synthesis of nylon and other synthetic fibers and resins (1). The US Environmental Protection Agency (EPA) has set the Maximum Contaminant Level (MCL) for cyanide in drinking water to be 0.20 ppm (2). Thus, a good cyanide chemosensor should give response to the presence of cyanide at the concentration lower than 0.20 ppm.

Of all the reported cyanide chemosensors (3), the colorimetric types possess some special advantages: the instrumentation is widely available, and the detection process is possible to be observed by the naked eye (the detection could even be conducted by one person without any instrumentation) (4). So far, the action modes of the cyanide chemosensors (5) are based on hydrogen-bonding (6), metal coordination (7), or bond-forming reactions between the nucleophilic cyanide and either an electrophilic carbon (8a, 8b) or a boron center (8c, 8d). However, these modes do not always work well, directly leading to the comparatively scarce cyanide (or even anion) chemosensors, in comparison with the relatively large number of cation chemosensors, since we know much about the rules of coordination chemistry between ligands and cations but have poor knowledge of the interactions between com-

pounds and anions (9). Also, the influence of halogen anions is another problem to be overcome, which tend to mask the response of cyanide (10), especially fluoride anions.

With the aim of developing new cyanide chemosensors, recently we raised another indirect strategy based on the ligand exchange mechanism (11): to find good anionic chemosensors in the reported good cationic chemosensors, since the anions might capture cations from the formed complex of the cations and their corresponding chemosensors, with a detectable optical signal (including color change). This is really possible if the stability constant of the complex formed by the anion and the cation is larger than that of the complex of the cation and its chemosensor (12). Actually, we have successfully obtained some "new" colorimetric cyanide sensors; however, high sensitivity and selectivity could not be achieved simultaneously. For example, in the zincon system, the sensitivity toward cyanide is as high as 0.13 ppm, but fluoride anions give a response similar to that of cyanide (12a). Also, in the sodium diethyldithiocarbamate (DDTC) system, the selectivity is good but the sensitivity is not high (about 3 ppm) (12b). Although these results were not good enough, they indicated that the sensing behavior of these compounds were different from each other, due to their different chemical structures. Thus, it was possible to find better cyanide chemosensors by utilizing the proposed indirect approach. Considering that the previously used compounds were traditional reagents for copper ions with high stability constants, we thought that perhaps we could find better "new" cyanide sensors in the range of synthetic chemosensors of copper ions with lower stability constants.

With this idea in mind, after thinking of some candidates, we attempted to utilize a rhodamine-based dye, compound **I**, as a potential new cyanide sensor, which was reported to be a good copper ion sensor with high sensitivity and selectivity ($K_a = 69\ 110$) (13). Our experimental results

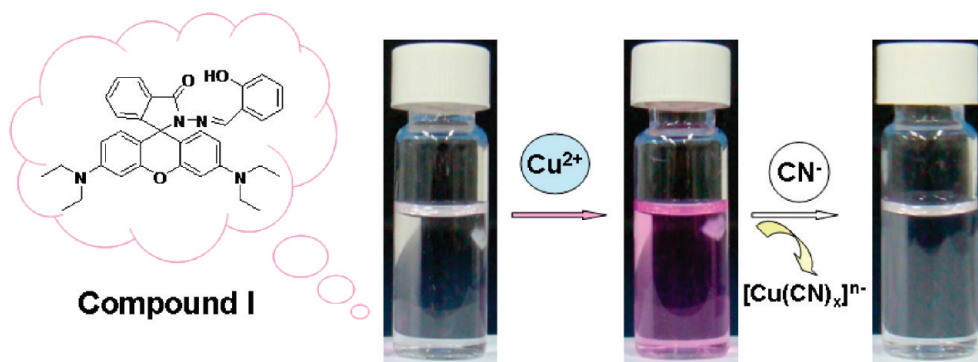
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Chart 1



confirmed the quite excellent sensing behavior of compound **I** toward copper ions: the colorless solution changed to magenta only in the presence of copper ions at very low concentration ($0.25 \mu\text{M}$). Excitingly, upon the addition of trace cyanide, the magenta solution went back to colorless immediately (Chart 1). Other experiments further demonstrated the good selectivity of the complex of compound **I** and copper ions toward cyanide. Herein, we report the interesting experimental results in detail.

EXPERIMENTAL SECTION

Materials and Instrumentations. Compound **I** was obtained following literature procedures (13). All reagents were of analytical reagent grade and were used without further purification. Doubly distilled water was used for all experiments. $\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, NaCN , KSCN , NaCl , KBr , KI , NaHSO_4 , Na_2SO_4 , $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$, NaClO_4 , NaNO_2 , NaIO_3 , NaF and KOH were purchased from Sinopharm Chemical Reagent Beijing Co., Ltd. UV-visible spectra were obtained using a Shimadzu UV-2550 spectrometer, and the pH values were determined by using a Delta 320 pH meter.

Preparation of Solutions of Metal Ions and Anions. A 0.1 mmol portion of each inorganic salt ($\text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}$, 24.2 mg ; NaCl , 5.8 mg ; KSCN , 9.8 mg ; KBr , 11.9 mg ; KI , 16.6 mg ; Na_2SO_4 , 14.2 mg ; NaClO_4 , 12.2 mg ; NaF , 4.2 mg ; NaNO_2 , 6.9 mg ; NaHSO_4 , 12 mg ; NaIO_3 , 19.8 mg ; $\text{NaH}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$, 15.6 mg ; NaCN , 4.9 mg) was dissolved in distilled water (10 mL) to afford a $1 \times 10^{-2} \text{ mol/L}$ aqueous solution. Tris-HCl buffer solutions (pH 7.0) were prepared using 0.01 M Tris, with the proper amount of HCl adjusted by a pH meter. The stock solutions could be diluted to the desired concentrations with water when needed. A $5.0 \times 10^{-4} \text{ mol/L}$ stock solution of compound **I** was prepared in acetonitrile; then $200 \mu\text{M}$ of this stock solution was added to a 10 mL glass tube and diluted with Tris-HCl (10 mM , pH 7.0) buffer and acetonitrile to obtain the solutions of **I** ($10 \mu\text{M}$) in Tris-HCl buffer containing 50% (v/v) water/ CH_3CN .

UV Absorption Changes of **I by Cu^{2+} .** A solution of **I** ($10 \mu\text{M}$) was prepared in Tris-HCl (10 mM , pH 7.0) buffer containing 50% (v/v) water/ CH_3CN ; then 3.0 mL of the solution of **I** was placed in a quartz cell (10.0 mm width) and the UV absorption spectrum was recorded before and after the addition of Cu^{2+} to the solution of **I**.

UV Absorption Changes of **I + Cu^{2+} with CN^- .** A solution of **I** ($10 \mu\text{M}$) was prepared in Tris-HCl (10 mM , pH 7.0) buffer containing 50% (v/v) water/ CH_3CN ; then 3.0 mL of the solution of **I** was placed in a quartz cell (10.0 mm width) and the UV absorption spectrum was recorded. After the solution of Cu^{2+} was added to **I**, the solution of NaCN was introduced in portions and the UV absorption changes were recorded at room temperature each time.

UV Absorption Changes of **I + Cu^{2+} with Other Anions.** The solutions of anions were prepared in distilled water. UV absorp-

tion changes of **I** ($1.0 \times 10^{-5} \text{ mol/L}$) + Cu^{2+} ($3.0 \times 10^{-6} \text{ mol/L}$) were recorded before and after the addition of anions to the solution of **I**. The concentrations of the anions were $7.0 \times 10^{-6} \text{ mol/L}$.

UV Absorption Changes of **I + Cu^{2+} with CN^- and Other Anions.** The UV absorption changes of **I** ($1.0 \times 10^{-5} \text{ mol/L}$) + Cu^{2+} ($3.0 \times 10^{-6} \text{ mol/L}$) were recorded before and after the addition of NaCN and all the other anions ($7.0 \times 10^{-6} \text{ mol/L}$).

RESULTS AND DISCUSSION

Compound **I** was easily synthesized from rhodamine **B** by a two-step reaction. It was designed to chelate with metal ions via its carbonyl O, imino N, and phenol O atoms (13, 14). A solution of **I** in Tris-HCl buffer (5 mM , pH 7.0) or organic media was colorless and weakly fluorescent, indicating that the spirolactam form of **I** existed predominantly. We also found that a solution of **I** ($10 \mu\text{M}$) in 50% (v/v) buffered (10 mM Tris-HCl, pH 7.0) water/ CH_3CN displayed an obvious magenta color in the presence of $\text{Cu}(\text{II})$ at the micromolar level. As reported in the literature (13), the addition of copper ions also caused a large change in the fluorescent intensity of **I**; however, this fluorescent change did not lead to good experimental results, when applied to the detection of cyanide through an indirect strategy. Thus, in this paper, we only reported the sensing behavior of color changes.

Figure 1 and Figure S1 (Supporting Information) show the UV-vis spectra of the solution of **I** in the presence and absence of copper ions. It was easily seen that **I** did not absorb in the range of visible light ($400\text{--}700 \text{ nm}$), and its curve was nearly overlapped with the baseline. Upon the addition of up to 2 equiv of $\text{Cu}(\text{II})$, the absorbance was significantly enhanced ($>200\text{-fold}$) and a new peak at 555 nm appeared, suggesting the clear formation of the ring-opened amide form of **I** (13). While the concentration of Cu^{2+} was $2.0 \times 10^{-5} \text{ mol/L}$, the absorption value of the peak at 555 nm was as high as 1.02, which should be large enough for the detection of cyanide in the next step. Also, at this time, the original colorless solution of **I** became magenta. Thus, these obtained experimental results were consistent with those reported previously (the difference should be caused by the different measuring conditions, since the test was sensitive to the pH value of the solution). Also, according to the literature, the association constant of the complex formed between **I** and copper ions was calculated to be $K_a = 69\ 110$ (13), which was much smaller than the stability

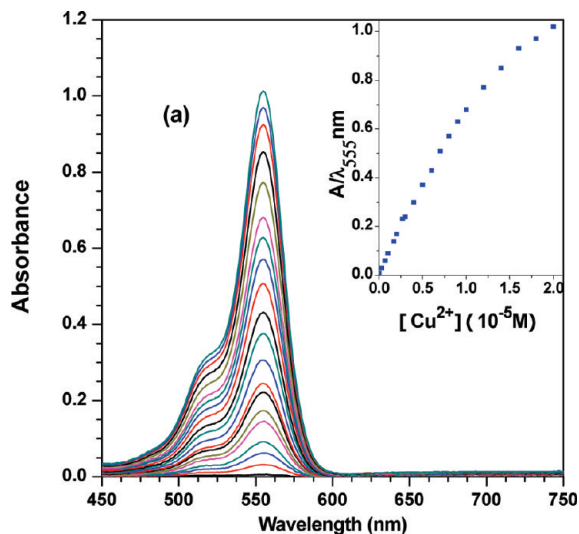
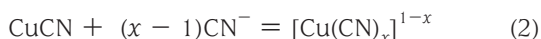


FIGURE 1. UV-vis spectra of **I** (10 μM) in Tris-HCl (10 mM, pH 7.0) buffer containing 50% (v/v) water/ CH_3CN in the presence of different amounts of Cu(II). Inset: absorbance at 555 nm as a function of the concentration of copper ions.

constant of copper ions and cyanide (eqs 1 and 2) (15). Equation 1 shows the reaction between Cu^{2+} and CN^- :



where CuCN is a white precipitate. Equation 2 shows the reaction between CuCN and CN^- :



where $x = 2-4$ and is generally 2 or 4. The stability constants (K) are as follows: $[\text{Cu}(\text{CN})_2]^-$, $K = 1.00 \times 10^{24}$; $[\text{Cu}(\text{CN})_4]^{3-}$, $K = 2.00 \times 10^{30}$. Thus, we thought that the added CN^- might capture the copper ions from the complex of **I** and cause a color change, as demonstrated in Chart 1.

As expected, upon the addition of cyanide, the peak at 555 nm of the complex of **I** and copper ions decreased (Figure 2 and Figure S2 (Supporting Information)). Thus, we could now give the following summary: at first, the addition of copper ions to the solution of **I** caused the appearance of the absorption peak at 555 nm, indicating the formation of the complex of **I** and copper ions; then in the second stage, due to the much higher stability constant of cyanide and copper ions, the added cyanide could snatch the copper ions from the complex of **I** and copper ions, resulting in a sharply decreased absorption intensity accompanied by a the color change. Thus, it was reasonable that when more copper ions were added, more cyanide was needed to coordinate with the copper ions added in the first step to give an obvious optical signal or color change, assuming that the concentration of **I** was high enough and had nearly no influence. Therefore, we fixed the concentration of **I** at 10 μM ; however, we changed that of the copper ions from 0.3, 0.4, and 0.7 to 2.0×10^{-5} mol/L. As shown in Figure 2, the added cyanide caused a decreased absorption intensity at 555 nm.

Since the concentrations of the copper ions in the four cases were different, to obtain a similar decreasing effect, different amounts of cyanide were required. For example, as demonstrated in Figure 2a, the concentration of the copper ions was only 3.0×10^{-6} mol/L; thus, the resultant solution responded to the added cyanide at a concentration as low as 1.0×10^{-7} mol/L ($\Delta A = 0.024$). When the concentration of cyanide was increased, the intensity further decreased. When the concentration of cyanide was 5.0×10^{-7} mol/L, the absorption change became 0.054, large enough to be regarded as the detection limit of cyanide. In the case of Figure 2b, the concentration of copper ions was 4.0×10^{-6} mol/L; to obtain an effect similar to that of Figure 2a, the concentration of cyanide should be as high as 2.0×10^{-6} mol/L ($\Delta A = 0.061$, slightly greater than 0.054). This concentration of cyanide (2.0×10^{-6} mol/L), however, could lead to an absorption difference as larger as 0.12, in the case of Figure 2a.

On further increases in the concentrations of copper ions, the sensitivity of the solution toward cyanide was even lower (Figure 2c,d). Also, as demonstrated in the insets in Figure 2, there was a nearly linear relationship between the absorbance at 555 nm and the concentration of cyanide. These results not only proved our thoughts but also exhibited another advantage of the indirect strategy for the development of cyanide chemosensors: by adjusting the concentrations of the copper ions, the detection range of cyanide could be modulated. Thus, we could create reagents with different ratios of compound **I** and copper ions to detect cyanide in different concentration ranges, according to the practical requirements. This point, coupled with the nearly linear relationship between the signal and the concentration of analytes, perhaps could not be found in the chemosensors reported so far from the normal direct designing strategy, as mentioned in the Introduction.

To see the sensitivity of the complex of **I** and copper ions toward cyanide more clearly, we presented the response of the complex of **I** and copper ions for CN^- in 50% (v/v) buffered (10 mM Tris-HCl, pH 7.0) water/ CH_3CN by another method (Figure 3 and Figure S3 (Supporting Information)). It was easily seen that the absorption change at 555 nm was very obvious; for example, the absorbance change $A_0 - A$, where A_0 is the original absorption of the solution of the complex of **I** and copper ions at 555 nm in the absence of cyanide and A is the absorption in the presence of different concentrations of cyanide, was as large as 0.024 while the concentration of cyanide was 0.0026 ppm (that is, at 0.1×10^{-6} mol/L) (Figure 3a). When the concentration of cyanide increased to 0.18 ppm (that is, at 7.0×10^{-6} mol/L), lower than the maximum allowed concentration (0.2 ppm) according to the WHO guidelines, the change was even greater (0.17). Corresponding to Figure 2b-d, the curves of absorption differences at 555 nm versus the concentration of cyanide are demonstrated in Figure 3b-d.

To evaluate the cyanide-selective nature of **I**, possible absorption changes caused by other anions, including HSO_4^- , H_2PO_4^- , F^- , SCN^- , IO_3^- , I^- , Br^- , ClO_4^- , NO_2^- , Cl^- ,

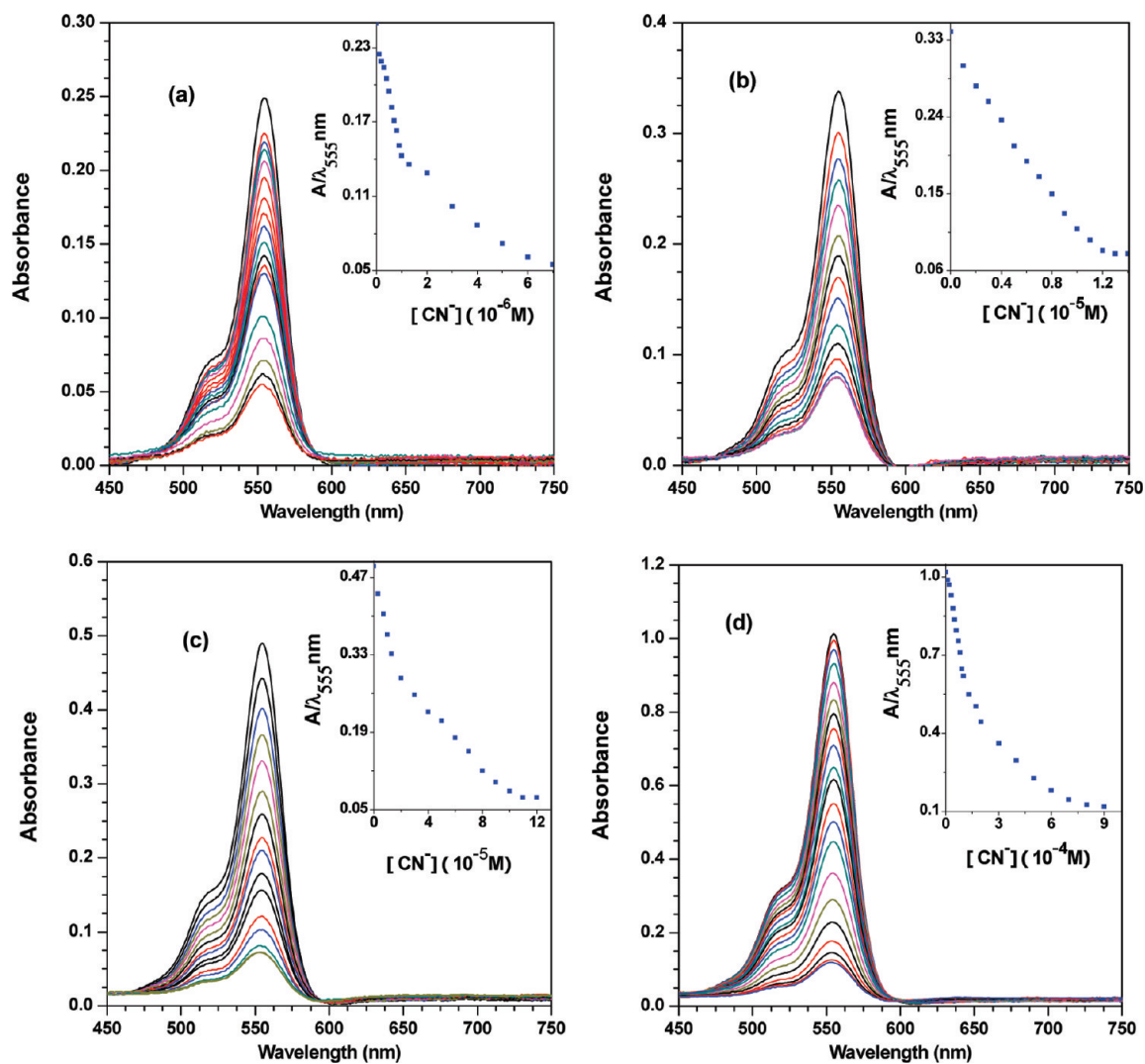


FIGURE 2. (a) UV-vis spectra of **I** ($10\ \mu\text{M}$) and Cu^{2+} ($3.0 \times 10^{-6}\ \text{mol/L}$) in Tris-HCl (10 mM, pH 7.0) buffer containing 50 % (v/v) water/ CH_3CN in the presence of different amounts of CN^- . Inset: absorbance at 555 nm as a function of CN^- concentration. (b) UV-vis spectra of **I** ($10\ \mu\text{M}$) and Cu^{2+} ($4.0 \times 10^{-6}\ \text{mol/L}$) under the same conditions as in (a). Inset: absorbance at 555 nm as a function of CN^- concentration. (c) UV-vis spectra of **I** ($10\ \mu\text{M}$) and Cu^{2+} ($7.0 \times 10^{-6}\ \text{mol/L}$) under the same conditions as in (a). Inset: absorbance at 555 nm as a function of CN^- concentration. (d) UV-vis spectra of **I** ($10\ \mu\text{M}$) and Cu^{2+} ($2.0 \times 10^{-5}\ \text{mol/L}$) under the same conditions as in (a). Inset: absorbance at 555 nm as a function of CN^- concentration.

and SO_4^{2-} , were studied. It was found that anions other than cyanide did not lead to apparent changes in the absorption intensity of the solution of the complex of **I** and copper ions. Increasing the concentrations of these anions from 7.0×10^{-6} to $1.3 \times 10^{-5}\ \text{mol/L}$ gave similar experimental results. Thus, the selectivity profile for CN^- over other anions was remarkably high. We further conducted competition experiments using solutions containing cyanide and all the other anions. As shown in Figure 4, the complex of **I** and copper ions could report the presence of trace cyanide: after the addition of 1.0 equiv of cyanide ions, the absorption band at 555 nm nearly disappeared; however, nearly no change was observed in the presence of all the other anions. Also, considering it was possible that the selectivity and sensitivity would be affected by the existence of other cations (such as Fe^{2+} , Fe^{3+} , Zn^{2+} , Ag^+ , and Mg^{2+}) due to their competitive binding with compound **I**, we tested the possible influence of these five cations as an example. As shown in Figure S4 (Supporting Information), even though the concentrations

of these cations were slightly higher than that of copper ions, there were nearly no apparent differences observed during the experiments with and without the presence of these metal ions. Thus, this method for the probing of cyanide could still work well in the presence of other ions. Considering that some other common compounds, which could form stable complexes with copper ions, might have some influence, we further investigated the absorption behavior in the presence of EDTA, pyrophosphate, tartrate, salicylaldehyde, and *n*-butylamine as examples. As shown in Figure S5 (Supporting Information), except for EDTA, no great influence was observed, indicating that the utilization scope of compound **I** is not very limited.

Repeating the above experiments with different concentrations of compound **I**, although not good enough, similar results were obtained, further confirming the successful sensing behavior of this indirect strategy (Figure S6 (Supporting Information)). On the other hand, on changing the ratio of water and acetonitrile in the mixture solution or using another organic

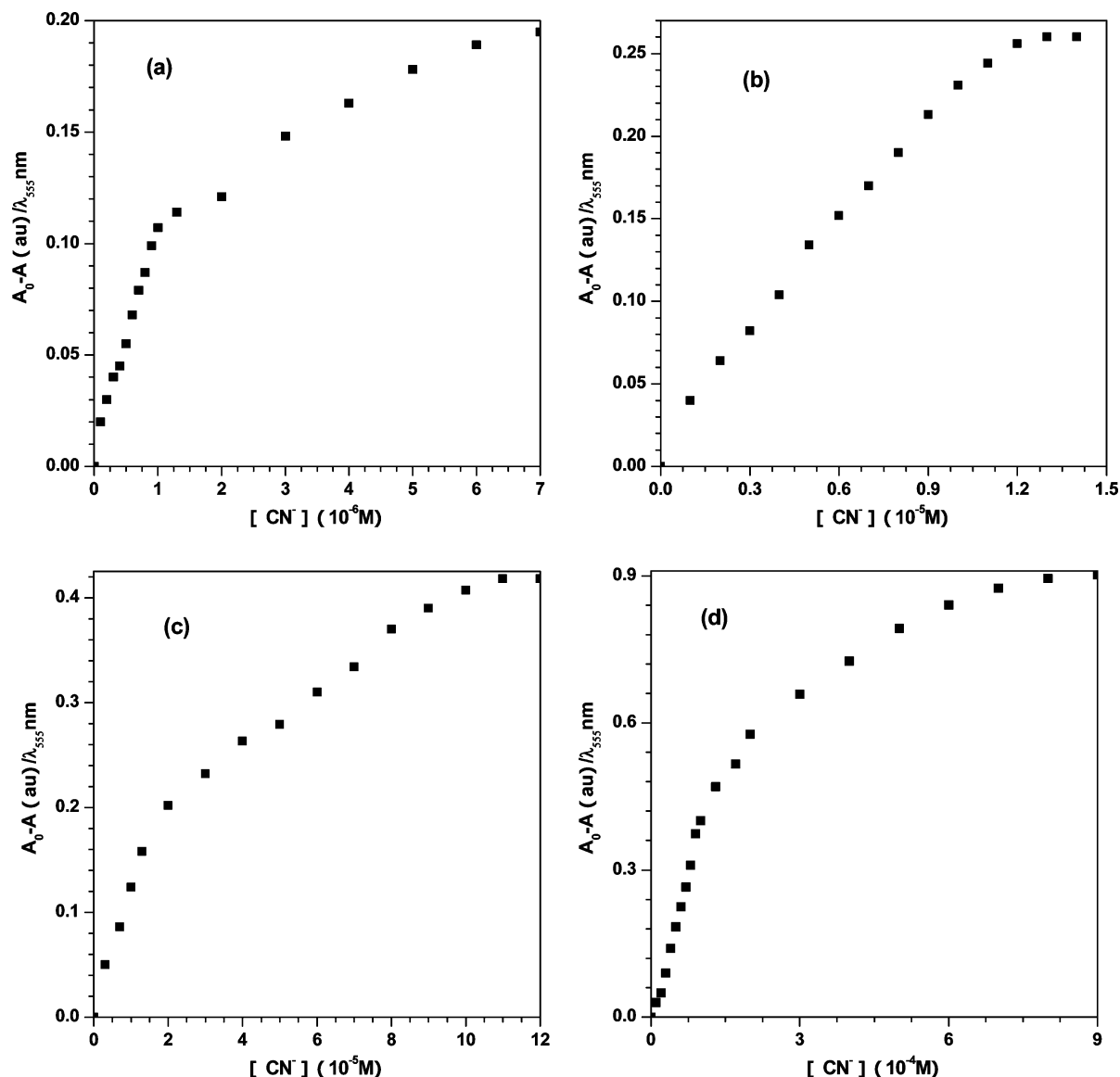


FIGURE 3. (a) Absorption difference at λ 555 nm versus the concentration of CN^- in Tris-HCl (10 mM, pH 7.0) buffer containing 50% (v/v) water/ CH_3CN with the concentrations of **I** and Cu^{2+} at 1.0×10^{-5} and 3.0×10^{-6} mol/L, respectively. (b) Absorption difference at λ 555 nm under the same conditions as in (a) with the concentrations of **I** and Cu^{2+} at 1.0×10^{-5} and 4.0×10^{-6} mol/L, respectively. (c) Absorption difference at λ 555 nm under the same conditions as in (a) with the concentrations of **I** and Cu^{2+} at 1.0×10^{-5} and 7.0×10^{-6} mol/L, respectively. (d) Absorption difference at λ 555 nm under the same conditions as in (a) with the concentrations of **I** and Cu^{2+} at 1.0×10^{-5} and 2.0×10^{-5} mol/L, respectively.

solvent, THF, instead of acetonitrile, similar results were also observed, but not as good as those reported above (Figure S7 (Supporting Information)).

As mentioned above, we want to develop “naked eye” colorimetric sensors; thus, we wondered if the relatively low detection limit of the complex of **I** and copper ions toward cyanide through the indirect method could lead to the direct naked eye sensing of cyanide. Accordingly, we took photos of the resultant solutions at different concentrations of the cyanide. Figure 5 demonstrates the process of change from magenta to colorless, by adjusting the concentration of the added cyanide from 1.0 to 9.0×10^{-5} mol/L. This color change was very apparent and could be easily seen by the naked eye. Also, it was easily seen that the magenta solution was “bladed” step by step, accompanied by an increase in the concentration of cyanide. Thus, perhaps, we could

estimate the possible concentration of cyanide in the testing samples just by comparing the color with the standard solutions. When we added 1 of 11 different anions (9.0×10^{-5} mol/L) in addition to cyanide or all of them to a solution of the complex of **I** and copper ions at pH 7.0 and room temperature ($T = 21 \pm 1$ °C) (Figure 6), the magenta color of the solution as well as the characteristic absorption bands of the complex of **I** and copper ions remained unaffected, indicating that no ligand displacement took place. That is, the addition of all 11 anions (9.0×10^{-5} mol/L) in addition to cyanide did not influence the magenta color of the solution of the complex of **I** and copper ions. Besides the colorimetric detection, compound **I** allowed for fluorescence detection of cyanide; however, this did not work as well as the colorimetric detection.

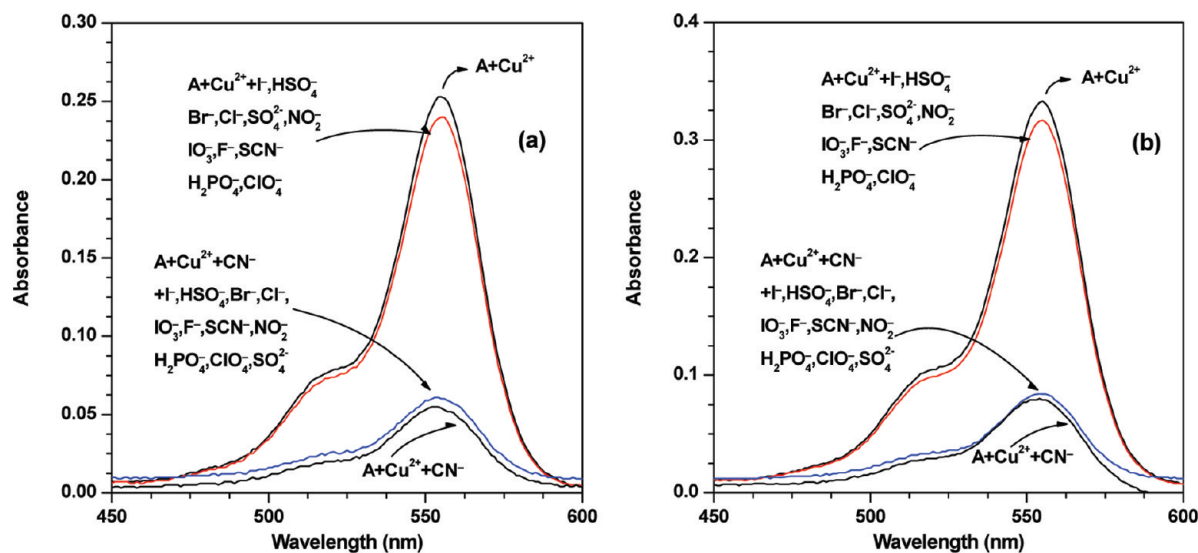


FIGURE 4. (a) UV-vis spectra of I in the presence of different anion mixtures (7.0×10^{-6} mol/L) in Tris-HCl (10 mM, pH 7.0) buffer containing 50% (v/v) water/ CH_3CN . The concentration of I was 1.0×10^{-5} mol/L, and that of Cu^{2+} was 3.0×10^{-6} mol/L. (b) UV-vis spectra of I at the presence of different anion mixture (1.3×10^{-5} mol/L) under the same conditions as in (a). The concentration of I was 1.0×10^{-5} mol/L, and that of Cu^{2+} was 4.0×10^{-6} mol/L.



FIGURE 5. Different solutions of I and copper ions in Tris-HCl (10 mM, pH 7.0) buffer containing 50% (v/v) water/ CH_3CN (1.0×10^{-5} and 7.0×10^{-6} mol/L, respectively) in the presence of different concentrations of CN^- . From left to right ($\times 10^{-5}$ mol/L): 0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, and 9.0.

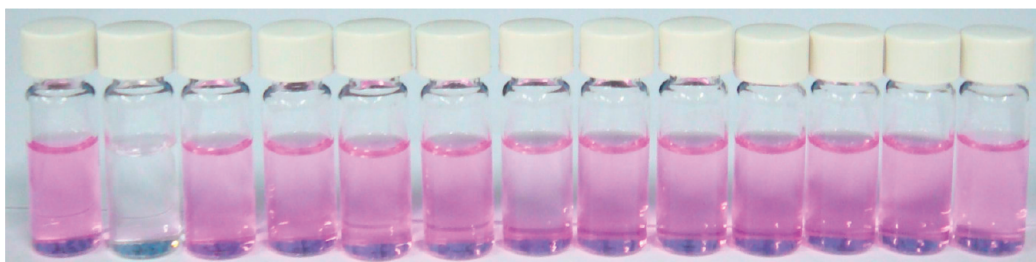


FIGURE 6. Different solutions of I and copper ions in Tris-HCl (10 mM, pH 7.0) buffer containing 50% (v/v) water/ CH_3CN (1.0×10^{-5} and 7.0×10^{-6} mol/L, respectively) in the presence of anion (9.0×10^{-5} mol/L). From left to right, mixtures of anions except CN^- , CN^- , F^- , Cl^- , I^- , IO_3^- , SO_4^{2-} , NO_2^- , Br^- , H_2PO_4^- , HSO_4^- , ClO_4^- , and SCN^- .

To investigate the practical application of chemosensor I, test strips were prepared by immersing a silica gel plate into a CH_3CN solution of I (5.0×10^{-4} mol/L) that was then dried in air. The test strips containing I were utilized to sense copper ions first. For the solutions of copper ions, different test strips were immersed for 10 s and then the obvious color change was observed: the higher the concentration of copper ions, the more apparent the color change from colorless to magenta. As depicted in Figure 7, the discernible concentration of copper ions could be as low as 1.0×10^{-5} mol/L. The same procedures were done for cyanide and different anions. As shown in Figure 8, the magenta color of the test strips faded



FIGURE 7. Photographs of the test strips with I (5.0×10^{-4} M) for the detection of Cu^{2+} in aqueous solution with different concentrations. From left to right (M): 0, 1.0×10^{-5} , 1.0×10^{-4} , 1.0×10^{-3} .

to pale when the concentration of cyanide was 1.0×10^{-2} mol/L; however, the immersion of these test strips in the



FIGURE 8. Photographs of the test strips with **I** (5.0×10^{-4} M) + Cu^{2+} (1.0×10^{-3} M) for the detection of CN^- in aqueous solution. From left to right: **I**, **I** + Cu^{2+} , **I** + Cu^{2+} + CN^- , **I** + Cu^{2+} + a mixture of anions (F^- , Cl^- , I^- , IO_3^- , SO_4^{2-} , NO_2^- , Br^- , H_2PO_4^- , HSO_4^- , ClO_4^- , SCN^-), **I** + Cu^{2+} + CN^- + the mixture of anions. The concentration of anions was 1.0×10^{-2} M.

solution mixture of other anions (1.0×10^{-2} mol/L), did not cause any color change, and the magenta color of the strips remained unaffected. When these strips were immersed in the solution of cyanide again, the color faded immediately. Thus, these strips could be easily carried with people at any moment for the detection of cyanide.

CONCLUSIONS

In summary, we have developed a selective rhodamine-based colorimetric chemosensor, **I**, for the detection of cyanide. The recognition of the copper ion gave rise to major color changes from colorless to magenta, which were clearly visible to the naked eye. Upon the addition of trace cyanide, the magenta color faded to colorless immediately, with a detection limit as low as 0.013 ppm ($\Delta A = 0.054$), much lower than the Maximum Contaminant Level for cyanide in drinking water (0.20 ppm) set by the US Environmental Protection Agency. Other anions had nearly no influence on the probing behavior of dye **I** toward cyanide. Especially, by adjusting the concentrations of the copper ions, the detection range of cyanide could be modulated, which should surely benefit its applications to cyanide detection in different concentration ranges, according to the practical requirements. Thus, the preliminary experimental results demonstrated the following: the well-known cation colorimetric chemosensor could be used to sense an anion, cyanide, sensitively and selectively by utilizing an indirect method. This perhaps is a novel idea to develop new anion chemosensors. Also, it is believed that many other good reported cation chemosensors could be found to be “novel” good anion chemosensors. Likewise, the anion chemosensors might also be applied to detect metal ions. The good selectivity and high sensitivity of the complex of **I** and copper ions toward cyanide make **I** a promising candidate in practical applications as a good cyanide probe.

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Supporting Information Available: Figures giving UV-vis spectra. This material is available free of charge via the Internet at <http://pubs.acs.org>.

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