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Thuy Van Thi Nguyen, Young Jun Seo

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Highly sensitive fluorescent sensor targeting $CuCl_2$ based on thiophene attached anthracene compound (TA)

Thuy Van Thi Nguyen[a], Young Jun Seo[a,b,*]

[a]*Department of Bioactive Material Sciences, Chonbuk National University, South Korea*
[b] *Department of Chemistry, Chonbuk National University, South Korea*

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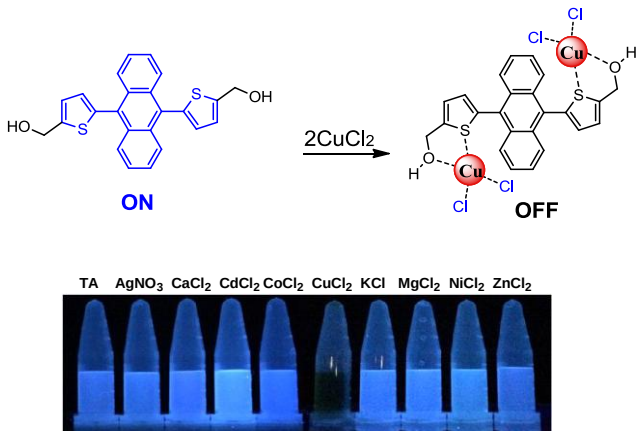
ABSTRACT

A novel thiophene attached anthracene (**TA**) based fluorescent compound was designed and synthesized. The **TA** showed a high quantum yield (Qy=0.34) in regard to fluorescence. We applied this **TA** compound to detect specific metal compound and found that it could identify **$CuCl_2$** from other metals through dramatic fluorescence change at λ_{max} = 460 nm. It showed strong quenching fluorescence property with **$CuCl_2$** while with other metal compounds it exhibited strong blue fluorescence emission. UV/Vis absorption spectroscopy clearly demonstrated that the quenching property of **TA** at λ_{max} = 460 nm was due to overlapping of the fluorescence peak of **TA** at λ_{max} = 460 nm and the absorption band of **$CuCl_2$** (from 190 nm to 525 nm). Binding constant (K'), which was 0.0895 mM^{-2}, indicated a complexation ratio between **TA** and **$CuCl_2$** as 1:2 and this interaction induced quenching property.

Development of novel types of photochromic compound is exceedingly important due to the possibility of their diverse applications especially for sensing of metal,[1] small molecule,[2] macromolecule[3] and biomolecule.[4] Fluorescent molecules are particularly sensitive to the changes in environment[5] and thus they could be used for diverse diagnostics, molecular imaging, and biophysics areas.[6] Thus, our goal is to develop novel fluorescent compound which is very sensitive to a specific material. Anthracene is a unique fluorescence material that has high fluorescence quantum yield, and can form dimerized structure under light illumination.[7] Thiophene is also a unique heterocyclic aromatic compound that can be used in thiophene-based oligopolymers to utilize the high electrical transfer property.[8] Our strategy to develop a photochromic compound involved combination of two units of anthracene and thiophene to generate a material with novel photophysical property. Based on this concept we designed and synthesized a thiophene attached anthracene compound (**TA**). Herein, we report a particular photophysical property of thiophene-based anthracene (**TA**) which has remarkable sensitivity to a specific metal, **$CuCl_2$**.

First, to obtain thiophene attached anthracene compound at two symmetric positions, a two-step reaction was performed. In the first step, (5-bromothien-2-yl) methanol (**2**) compound was synthesized from 5-bromo-2-thiophenecarboxaldehyde (**1**) via reduction using sodium borohydride ($NaBH_4$). Next, we coupled it with anthracene-9,10-diboronic acid bis(pinacol) ester (**3**) to produce thiophene attached anthracene compound (**TA**) using Suzuki coupling condition (Scheme 2).



Scheme 1. Structure of thiophene attached anthracene (**TA**) and its photo sensing ability to the specific metal.

* Corresponding author. *Department of Chemistry, Chonbuk National University*, Jeonju 561-756, South Korea. Fax: +82-63-270-3408; Tel.: +82-63-270-3417; e-mail: yseo@jbnu.ac.kr