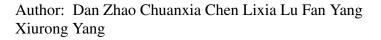
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A label-free colorimetric sensor for sulfate based on the inhibition of peroxidase-like activity of cysteamine-modified gold nanoparticles

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Abstract: A simple label-free colorimetric sensor for sulfate has been devised based on the 8 9 analyte-induced shielding of peroxidase-like activity of cysteamine-capped gold nanoparticles 10 (cyst-AuNPs). Aggregation triggered by sulfate through hydrogen bond and electrostatic 11 interaction gave rise to a remarkable decrease of the catalytic activity of AuNPs. By coupling with 12 3,3',5,5'-tetramethylbenzidine (TMB)-H₂O₂ chromogenic reaction, a novel colorimetric sensor for 13 detection of sulfate was established. Based on the signal amplification effect of the catalytic 14 reaction, a detection limit as low as $0.16 \,\mu$ M was obtained by virtue of UV-vis spectroscopy or 4 15 μ M with the naked-eye observation. The as-proposed sensor exhibited an excellent selectivity over 16 other common anions and metallic ions. In view of these characteristics, such sensing probe 17 features simplicity, cost-effectiveness, and naked-eye screening. These advantages make this 18 sensor a powerful protocol for the quantitative detection of sulfate in water samples with 19 satisfactory results.

Key words: Colorimetric sensor, Sulfate, Gold nanoparticles, Peroxidase-like activity,
3,3',5,5'-tetramethylbenzidine.

22 1. Introduction

The specific recognition and sensing of anions has been an active field of research owing to 23 their ubiquity and the pivotal roles they play in the ecosystems^{1,2}. Sulfate is widely presented in 24 25 natural water and wastewater released by a number of industrial processes, such as in the chemical industry, metallurgy, electrolysis, papermaking and so on³. Additionally, magnesium sulfate is 26 27 always introduced into the mineral water to supply the essential trace element of human body. 28 According to Environmental Protection Agency (EPA) of USA, the maximum tolerated concentration of sulfate in drinking water is 250 ppm⁴. However, the abnormal concentration of 29 30 sulfate can affect the metabolism of aquatic plants and lead to diseases such as diarrhea, gastroenteritis and so on⁵. Moreover, sulfuric acid has been reported to be the cause of acid rain. 31 32 The level of sulfate is considered to be an important indicator or tracer of the effects of factory and automobile exhaust gases⁶. Thus, sulfate detection is of great significance for clinical diagnosis as 33 well as water quality and environment monitoring. To date, many strategies, such as 34 spectrophotometry, gravimetric method, ion chromatography and microbial method⁷⁻⁹ have been 35 36 documented for the quantification of sulfate. Despite of high accuracy, most of these methods 37 suffer from defects of high cost, time-consuming experimental procedure and sophisticated 38 instrument manipulation. Consequently, there is a great need to further develop simple, reliable 39 and low-cost methods for rapid and sensitive determination of sulfate.

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