Highly Fluorescent and Stable Blue-Emitting Copper Nanoclusters Protected by Thiolated-PEG for Biosensor

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Abstract

Recently, the copper nanoclusters provide an alternatively promising candidate for various applications such as bio-imaging and bio-sensors, because the materials costs of the precursors for the synthesis of Cu cluster are substantially lower with for gold or silver precursors to obtain the gold or the silver nanoclusters. Several synthesized copper cluster, however; revealed a lack of stability against oxidation at the aqueous surrounding. To solve this problem, we proposed a synthesis approach to obtain the highly fluorescent and strongly stable blue-emitting copper nanoclusters through the chemical reduction of copper ions in the presence of the thiolated-PEG, the polymer of ethylene oxide with thiol chains with average M.W. 500, and NaBH4 as reducing reagent at 70 for 24 hours. The as-prepared copper nanoclusters showed the bright blue fluorescence with 30.6% of relative quantum yield (QY) in an aqueous system, and the fluorescence was responsive to pH in that with adjusting the pH from 5 to 7. Furthermore, the thiolated-PEG copper nanoclusters not only could be stored at room temperature for at least one month but showing excellent stability in the high electrolyte and complex matrix environment. Interestingly, the thiolated-PEG copper nanoclusters even could resist against GSH and H2O2. According to the mentioned above properties, we utilized the relationship between the fluorescence of copper nanoclusters and the pH value of the surrounding to design the urea sensor through the reaction of urea and urease to produce the ammonia that causing pH value change. The proposed method could obtain the good linear range from 0.098 to 1.56 mM for sensing urea and LOD is 32 uM. Moreover, the strategy could be exemplified by the analysis of urease in human plasma with high sensitivity and stability.

Keywords: Copper Nanoclusters, Thiolated, PEG, pH sensor, Urea, Urease

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