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In situ synthesized and embedded silver nanoclusters into poly vinyl alcohol-borax hydrogel as a novel dual mode "on and off" fluorescence sensor for Fe (III) and thiosulfate

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ABSTRACT

Herein, a novel method has been developed for in situ synthesis and embedding of silver nanoclusters (AgNCs) into polyvinyl alcohol and borax hydrogel (PBH) without adding any reducing agent. A three-dimensional network of polyvinyl alcohol and borax is formed, and at the same time the silver ions penetrate into the hydrogel, reduced to silver and trapped into the hydrogel bed. The characteristics of this hydrogel nanocomposite were investigated by energy dispersive X-ray spectroscopy and transmission electron microscopy (TEM). It was also observed that the fluorescence intensity of embedded AgNCs into polyvinyl alcohol and borax hydrogel (AgNCs-PBH) was enhanced and quenched in the presence of Fe (III) and thiosulfate, respectively. Therefore a novel dual on-off fluorescence sensor was developed based on polyvinyl alcohol-borax hydrogel for the first time. After preparing this new probe, the effect of Fe (III) and thiosulfate was investigated. The size-depending of label free AgNCs was found to be responsible for the enhancing and quenching of the fluorescence as well as obvious color changing. Under the approved condition, the linear ranges were validated over the concentration of 0.14-27.0 μmol L^{-1} and 0.1-1.0 μmol L^{-1} for Fe (III) and thiosulfate, respectively. The limit of detection based on three times the standard deviation of the blank was 0.045 and 0.060 μmol L^{-1} for Fe (III) and thiosulfate, respectively. The relative standard deviation for intra-day and inter-day determinations of both Fe (III) and thiosulfate were in the range