

## Author's Accepted Manuscript

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Nahid Pourreza, Matineh Ghomi



PII: S0039-9140(17)31075-5  
DOI: <https://doi.org/10.1016/j.talanta.2017.10.035>  
Reference: TAL18033

To appear in: *Talanta*

Received date: 10 June 2017  
Revised date: 17 October 2017  
Accepted date: 20 October 2017

Cite this article as: Nahid Pourreza and Matineh Ghomi, 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, *Talanta*, <https://doi.org/10.1016/j.talanta.2017.10.035>

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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**

Nahid Pourreza\*, Matineh Ghomi

*Department of Chemistry, Faculty of Science, Shahid Chamran University of Ahvaz, Ahvaz, Iran.*

\*Corresponding author Email: npourreza@scu.ac.ir Tel: +98 6133331042 Fax: +98 6133337009

**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-dependence 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  $\mu\text{mol L}^{-1}$  and 0.1-1.0  $\mu\text{mol L}^{-1}$  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  $\mu\text{mol L}^{-1}$  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

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