Colloids and Surfaces A: Physicochem. Eng. Aspects 414 (2012) 174–179

Contents lists available at SciVerse ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

journal homepage: www.elsevier.com/locate/colsurfa

Colloidal ZnSe quantum dot as pH probes for study of enzyme reaction kinetics by fluorescence spectroscopic technique

Zhi Chen [a,*], Dudu Wu [b]

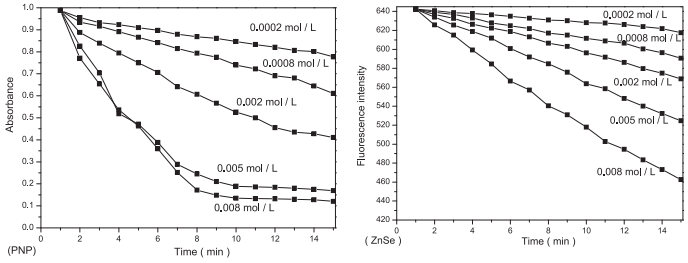
[a] Center of Analysis, Guangdong Medical College, Dongguan 523808, PR China
[b] School of Pharmacy, Guangdong Medical College, Dongguan 523808, PR China

HIGHLIGHTS

- Water-soluble ZnSe quantum dots (QDs) modified by mercaptoacetic acid were used to determinate H^+.
- ZnSe QDs were successfully used as pH probes for enzyme-catalyzed reaction.
- ZnSe QDs could improve stability, sensitivity and a detecting range to determine H^+ compared to PNP.

GRAPHICAL ABSTRACT

Using colloidal ZnSe quantum dots as pH probes could improve stability, sensitivity and a monitoring range for determination of H^+ as compared to the traditional analytical methods based on *p*-nitrophenoxide (PNP).



ARTICLE INFO

Article history:
Received 30 March 2012
Received in revised form 28 July 2012
Accepted 5 August 2012
Available online 19 August 2012

Keywords:
Colloidal ZnSe quantum dots
Fluorescence intensity
pH probe
Enzyme
Hydrolysis

ABSTRACT

Water-soluble colloidal ZnSe quantum dots (QDs) modified by mercaptoacetic acid (MAA) were used to determinate H^+ in aqueous solutions by fluorescence spectroscopic technique. The results showed that the fluorescence of the water-soluble colloidal ZnSe QDs could be quenched by H^+ and the fluorescence intensity of the water-soluble QDs decreased linearly as the pH varied from 4.5 to 7.0. Based on this phenomenon, a convenient, rapid and specific method to determination of enzyme reaction kinetics was proposed. The modified ZnSe QDs were successfully used as pH probes in monitoring the hydrolysis of glycidyl butyrate catalyzed by *porcine pancreatic lipase* (PPL). The proposed method was found to improve stability, sensitivity and a monitoring range for determination of H^+ as compared to the already described analytical methods based on *p*-nitrophenoxide (PNP).

1. Introduction

Semiconductive colloidal quantum dots (QDs) that exhibit quantum confinement effect have drawn significant attention over the past decade [1]. Compared with traditional organic fluorophores, QDs have size-dependent tunable photoluminescence with broad excitation spectra and narrow emission bandwidths, which allow simultaneous excitation of particles of different-sized QDs at a single wavelength. In addition, surface-passivated QDs are highly stable against photobleaching and are rendered the possibility of continuous or long term monitoring of slow biological processes. These unique properties of QDs make them appealing as in vivo and in vitro fluorophores in a variety of biological investigations [2]. For example, QDs have been successfully used for a variety of bioanalytical purposes, such as cell label, DNA probe, immunity label, and binding assays using fluorescence resonant energy transfer (FRET) to probe for target events [3–6].

Recently, valuable progress has been achieved in water-soluble QDs as ionic probe. Jin et al. reported the use of modified CdSe QDs for the sensitive determination of cyanide ions [7]. Xie et al.

* Corresponding author. Tel.: +86 769 22896376; fax: +86 769 22896560.
E-mail address: cz122@126.com (Z. Chen).

0927-7757/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.colsurfa.2012.08.021