Talanta 93 (2012) 233–238

Contents lists available at SciVerse ScienceDirect

Talanta

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

The discrimination between phospholipids of diverse structure and phosphacoumarins of various hydrophobicity through fluorescent response of Tb-doped silica nanoparticles decorated by cationic surfactant

Olga D. Bochkova[a], Asiya R. Mustafina[a,*], Alsu R. Mukhametshina[b], Vladimir A. Burilov[b], Andrey V. Nemtarev[a,b], Vladimir F. Mironov[a,b], Alexander I. Konovalov[a]

[a] A.E. Arbuzov Institute of Organic and Physical Chemistry of KSC of RAS, Arbuzov Street, 8, Kazan, Russia
[b] Kazan (Volga region) Federal University, Kremlevskaya str. 18, 420008 Kazan, Russia

ARTICLE INFO

Article history:
Received 22 December 2011
Received in revised form 31 January 2012
Accepted 10 February 2012
Available online 17 February 2012

Keywords:
Phospholipids
Silica nanoparticles
Biosensing
Luminescence
Tb(III) complex

ABSTRACT

The work represents colloids of silica nanoparticles displaying fluorescent response on biorelevant co pounds exemplified by phosphacoumarins and phospholipids. The luminescent properties of the collo arise from Tb(III) complexes doped into silica nanoparticles (SNs). The noncovalent decoration of S by dicationic surfactant with further interfacial binding of dye anions enables to develop colloids p grammed to display a substrate induced fluorescent response. The latter results from the quenching Tb(III) centered luminescence by dye anions through dynamic mechanism and subsequent displacem of quenching anions by the non-quenching substrates from the interface of SNs. Both negative cha and hydrophobicity of substrates are the key factors affecting the selectivity of the substrate induc fluorescent response. The peculiar effects of zwitter-ionic and anionic phospholipids on the fluoresc response have been revealed. The applicability of the fluorescent procedure in the sensing of impurit in commercial phosphatidylcholine is also introduced.

1. Introduction

The recognition of biorelevant anions through the fluorescent response is a top of current interest [1–8]. Lanthanide-centered luminescence is of particular importance for these purposes due to narrow bands in emission spectra and long lifetimes of the excited states, which enables to get good signal-to-noise ratio [9,10]. Though literature data introduce a plenty of excellent works concerning the recognition of biorelevant anions with the use of lanthanide complexes [1–8], many problems are still unresolved. For example the lack of kinetic and thermodynamic stability of lanthanide complexes significantly restricts biocompatibility and reusability of lanthanide based molecular sensors. The encapsulation of lanthanide containing luminophores into silica nanoparticles (SNs) is a route to protect lanthanide complexes from the degradation in bio-environment [11–17]. The easy modification of SNs provides the opportunity to increase the affinity towards biotargets and biocompatibility of SNs [18,19]. The reusability of nanomaterial should be noted as an additional advantage of SNs in a bioanalytical application.

The development of nanomaterial exhibiting substrate induc fluorescent response is commonly based on the energy trans between luminophores fixed on the silica surface or inserted i SNs and quenching molecules or ions located at the silica/wa interface. The fluorescent properties of dyes are widely appli in the development of nanosized biosensors, which is well doc mented in the articles [20–25]. The energy transfer was successfu applied to reveal biotin–avidin binding or to detect some b substrates [25–27]. Though there are some fine examples of t application of lanthanide centered luminescence in the dev opment of colloids with sensing functions [28–30,1,31,32], su publications are not enough. The peculiarity of the introduc herein approach is the discrimination between non-labeled su strates through the luminescent response with the use of d molecules as a probe. This approach is based on the quenching nanoparticles luminescence by some quenching ions (probes) w their further displacement by substrates, which in turn reesta lishes the initial emission of nanoparticles. The previously report use of copper or iron ions to quench the nanoparticles lumin cence with further stripping of metal ions from the interface some chelating anions should be also noted as a similar route get substrate responsive luminescent colloids [31–33].

The present work is a continuation of our previous repo on synthesis of highly luminescent Tb(III) doped SNs [17] a

* Corresponding author.
E-mail address: asiyamust@mail.ru (A.R. Mustafina).

0039-9140/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.talanta.2012.02.023