CORRESPONDENCE

Fluorescence Response of CdS Nanoparticles to Serum of Cardiac Patients: towards the Development of a Real Time Sensor for Heart Failure Detection

Nanotechnology may represent a tool for the improvement in our quality of life by providing a platform for new sensors or sensing elements – components that can be integrated into functional sensors- to monitor chemicals closely related to health issues. A sensor is a device that receives and responds to a signal or stimulus indicative of a real-world condition. The aim of the work presented here is to evaluate the response of CdS semiconductor nanoparticles to the serum of patients that have been evaluated for cardiac troponin, a protein that has been the subject of previous works related to its value in the prognosis, risk stratification and management of patients with acute coronary syndromes and myocardial necrosis (1-5). These conditions are major health issues, costing consumers millions of dollars through high insurance premiums and health care. Development of a real time sensor that targets the detection of cardiac troponin in the blood is a major technological challenge that can reduce mortality and as well as health care costs.

In a typical semiconductor, electrons can be excited by light from the valence band into the conduction band. The minimum energy required to promote electrons from the valence band into the conduction band represents the band gap of the semiconductor, which is inversely proportional to the nanoparticle size (6). Photo-excited electrons in the conduction band are energetically relaxed to lower energy states or traps, which are states resulting from defects in the structure of the nanoparticle or from the adsorption of chemicals on their surface. Emission of light results from relaxation of electrons from trap states into the valence band. When the trap states arise from the adsorption of molecules on the particle surface, the resulting luminescence is very sensitive to the chemical environment of the semiconductor nanoparticle: a potential sensor element to the specific chemical that created the trap state.

The inset in Figure 1 shows the absorbance spectrum of the CdS nanoparticles in dimethylsulfoxide (DMSO) employed for the work described here. The absorbance decreases with wavelength until the band edge of the semiconductor nanoparticle reaches around 515 nm. Based on the absorbance cutoff it is possible to estimate a nanoparticle diameter of about 2.4 nm (6). Serum samples of patients obtained from the Perea Hospital's Clinical Laboratory were analyzed for cardiac troponin levels using the Abbott method. A typical emission spectrum of a solution prepared by adding 90 μL of the serum of a patient with no detectable cardiac troponin to a solution containing the CdS nanoparticles is labeled as Patient 1 on Figure 1. No new emission bands besides those associated with the emission of the CdS nanoparticle appear in the spectrum. On the other hand, the photoluminescence of a mixture containing CdS nanoparticles and 90 μL of serum of a patient with a troponin level of 1.8 mg/mL, labeled as Patient 2 on Figure 1, exhibits bands around 545 nm, a low wavelength shoulder between 500 and 540 nm, and a high wavelength peak around 580 nm. The light emission

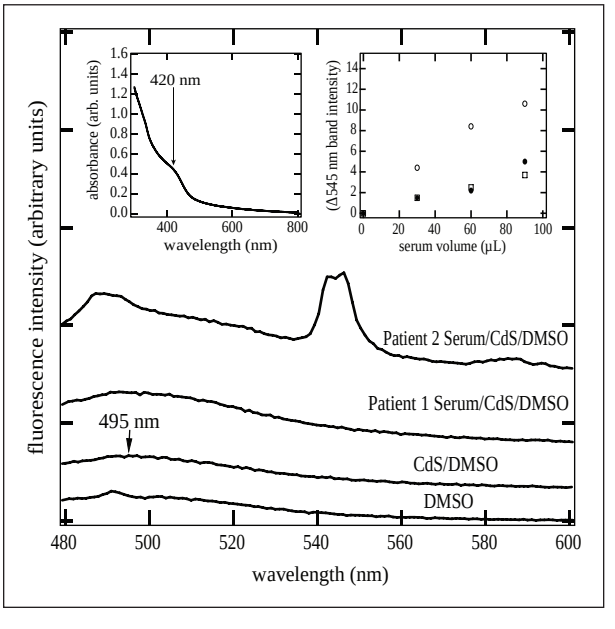

Figure 1. The inset at the upper left hand side shows a typical absorption spectrum of CdS nanoparticles. The fluorescence spectra of DMSO, the CdS nanoparticles in DMSO, the serum of patients with no detectable troponin (patient 1), and of a patient containing 1.8 mg/mL of troponin (patient 2). Excitation wavelength is 420 nm in all fluorescence measurements. The inset at the right hand side shows the change in fluorescence intensity at 545 nm as a function of the serum volume of patients with troponin levels of 15 (open circles), 12 (closed circles) and 2 (open squares) mg/mL.

intensity decreases linearly with dilution in this example as well as in four other serum samples containing troponin indicating that the emission is from the mixture and not an experimental artifact. Control experiments with troponin containing serum do not show these bands in the absence of the CdS particles. The number and chemical nature of other biomarkers that may be present in the serum samples limits the interpretation of the results in terms of specific troponin-CdS nanoparticle interaction (7). However, the results encourage pursuing further work focused on the use of CdS nanoparticles for the detection of cardiac troponin and other biomarkers related to coronary syndromes.

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E R R A T U M

The following correction should be noted for the article by Alberto de la Vega, MD, FACOG, RDMS and Ronald López-Cepero, BS, MS; entitled **Seasonal Variations in the Incidence of some Congenital Anomalies in Puerto Rico based on the Timing of Conception**, that appeared in the Puerto Rico Health Sciences Journal, Volume 28, Number 2, June 2009: Table 3 (Seasonal Variations in the Incidence of Open Neural Tube Defects in Puerto Rico from 1995 through 2005) should be as follows:

Table 3. Seasonal Variations in the Incidence of Open Neural Tube Defects in Puerto Rico from 1995 through 2005

Season	Conceptions resulting in live Births	Cases of Open Neural Tube Defects	Incidence/ 1000 live births	Relative Risk	95% confidence interval
Winter	116804	91	0.78	1(ref.)	
Spring	108363	86	0.79	1.02	0.76-1.37
Summer	102193	106	1.03	1.33	1.01-1.76
Autumn	113885	94	0.82	1.06	0.79-1.41
Total	441245	377	0.85		