CDTE QUANTUM DOTS MODIFIED BY BIOTIN-GLUTATHIONE CONJUGATE AS A COATING FOR BIOCONJUGATION

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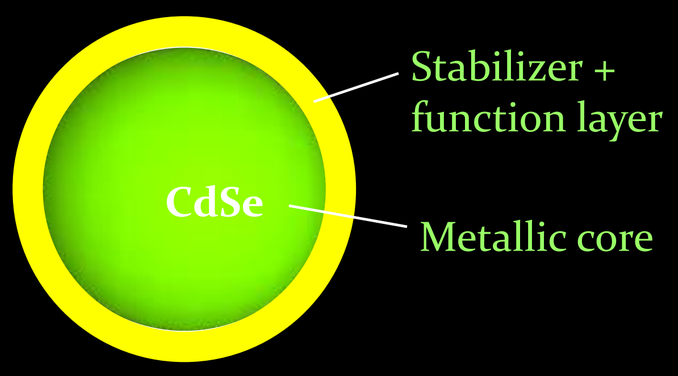
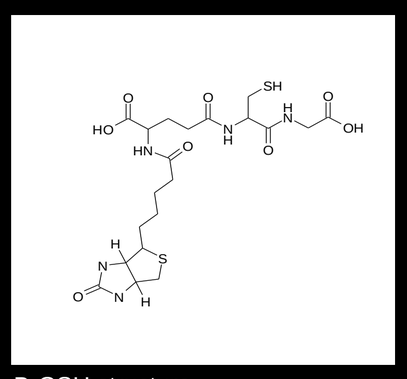
Introduction:

Quantum dots (QDs) with the dimensions in the range of 2–10 nm belong to the family of nanomaterials having a significant impact on chemical as well as biological research. QDs are semiconductor nanocrystals with unique spectral properties featured mainly by the size-tunable emissions due to quantum size effects and high resistance toward photobleaching. The emission spectra of homogenously sized QDs are narrower than typical fluorophores and a variety of QDs types can be produced covering almost whole spectral range.





B-GSH structure

Experimental:

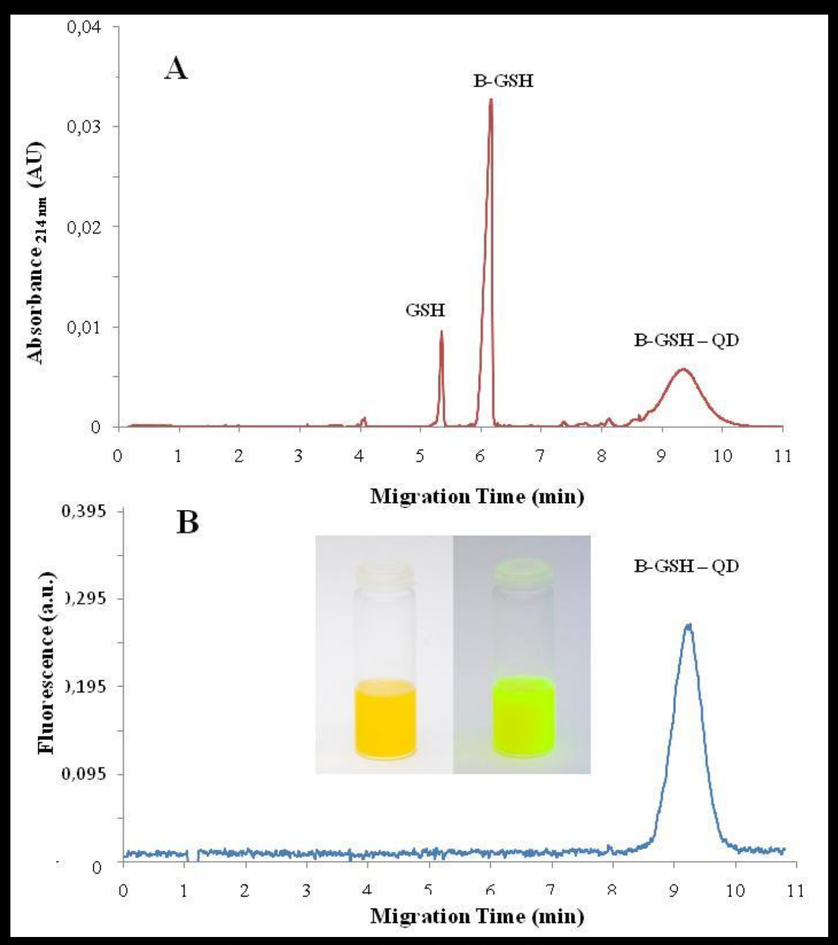
Biotin and GSH were conjugated via standard peptide bond using carboxy group of the biotin and amino group of the γ-glutamic acid. The biotinylation at the N-end of the tripeptide was the last step of the peptide synthesis.

Matrix-Assisted Laser Desorption/Ionization-Time of Flight Mass Spectrometry (MALDI-TOF MS) Ultraflex III instrument (Bruker Daltonik, Germany).

Samples (0.6 µl) pre-mixed with 2.4 µl of the matrix solution (saturated solution of alpha-cyano-4-hydroxycinnamic acid in water/acetonitrile mixture 1:1, *v/v*) and 0.6 µl of - deposited on a stainless steel MALDI target. Measurements in a reflectron positive ion detection arrangement

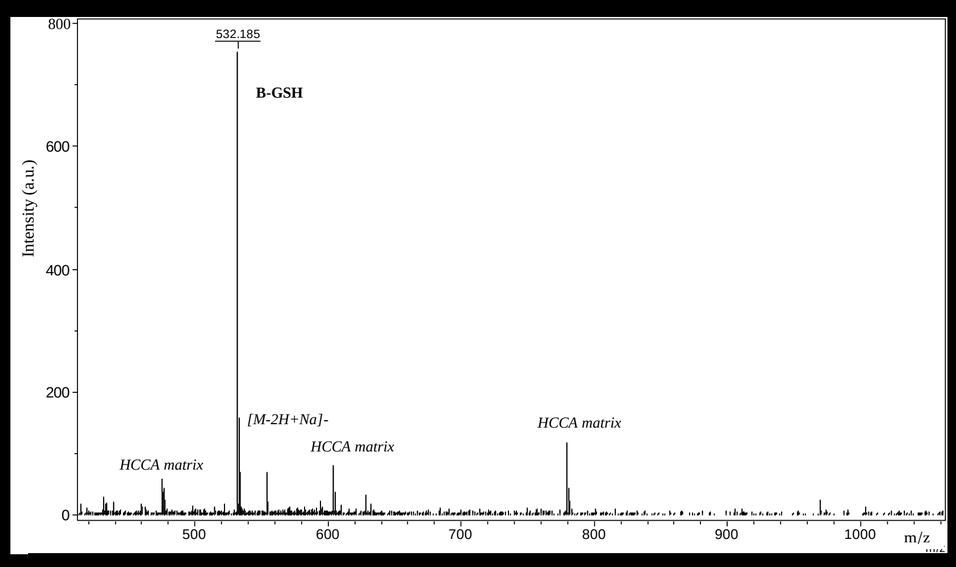
The synthesis of CdTe QDs and their subsequent coating were as follows: 330 µl of the $CdCl_2$ solution (c = 0.04 mol/L^{-1}) was diluted with 2.5 ml of water. During constant stirring, 8 mg of sodium citrate, 330 µl of Na_2TeO_3 solution (c = 0.01 mol/L^{-1}), 15 mg of B-GSH and 3.3 mg of $NaBH_4$ were added into water-cadmium(II) solution. The mixture was kept at 95°C under the reflux cooling for 2.5 hours.

Capillary electrophoresis (Beckman Coulter, PACE 5500) with absorbance detection at 214 nm and with the laser-induced fluorescence detection (Ar^+, λ_{ex} - 488 nm/ λ_{em} - 530 nm). Separation of the excess of B-GSH and GSH was carried out using uncoated fused silica capillary with 50 µm internal diameter and 375 mm b outer diameter. Total length was 47 cm and the effective length was 40 cm. Borate buffer (300 mmol/L^{-1}, pH 7.8) was used as a background electrolyte.

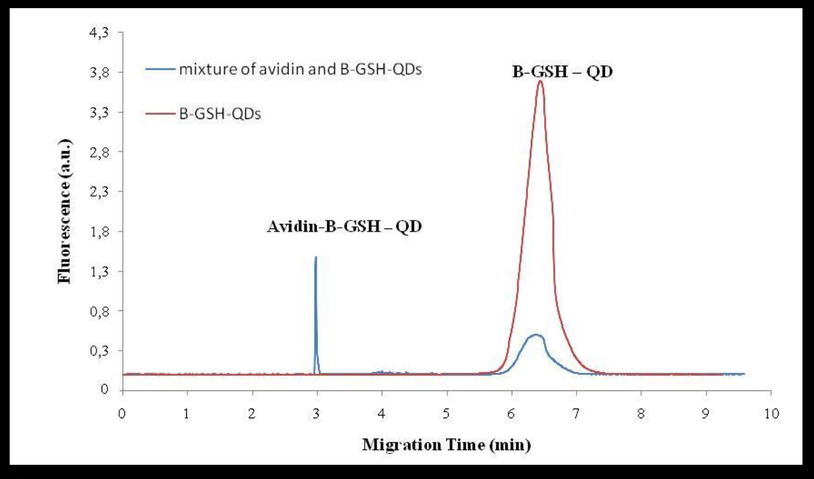


Electropherogram of the mixture of the B-GSH-QDs and excess B-GSH and GSH, BGE: 300 mmol/L^{-1} sodium borate buffer pH 7.8 , U: +20 kV, injection: 0.5 psi for 20 s, A) UV detection at 214 nm, B) LIF detection (488 nm/530 nm); inset: B-GHS-QDs under ambient light (left), B-GSH-QDs under UV light illumination (right)

Results:



MALDI-TOF MS spectrum obtained for B-GSH (matrix: alpha-cyano-4-hydroxycinnamic acid,)



Electropherogram of the mixture of the B-GSH-QDs and avidin solution, BGE: 20 mmol/L^{-1} sodium borate buffer pH 9.5, U: +20 kV, injection: 0.5 psi for 20 s, LIF detection (488 nm/530 nm)

Conclusions:

- ✓B-GSH was proven to be suitable compound for stabilizing and functionalizing of the CdTe based QDs
- ✓Biotinylated QDs coated by B-GSH are able to react with avidin (streptavidin)

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