evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

CdTe Quantum Dot Synthesis and Characterization

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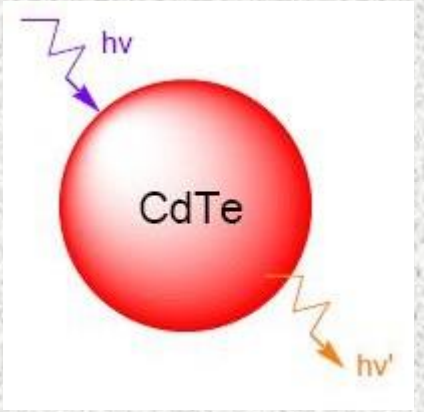
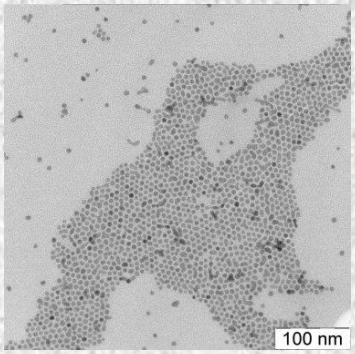
Reg.č.projektu: **CZ.1.07/2.3.00/20.0148**

Název projektu: Mezinárodní spolupráce v oblasti "in vivo" zobrazovacích technik

Cadmium telluride (CdTe) is a stable crystalline compound formed from cadmium and tellurium.





TEM

Use of CdTe

- CdTe is used to make thin film solar cells
- CdTe can be alloyed with mercury to make a versatile infrared detector material (HgCdTe)
- CdTe is also applied for electro-optic modulators
- CdTe doped with chlorine is used as a radiation detector for x-rays, gamma rays, beta particles and alpha particles.

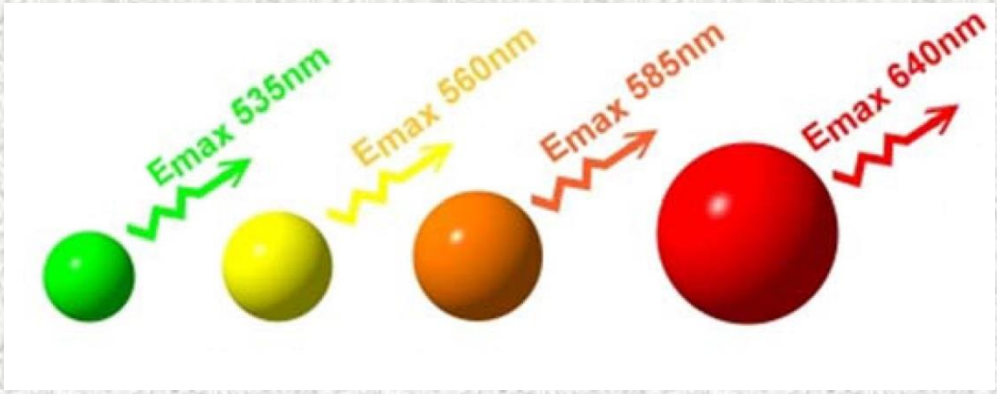
Preparation of CdTe QDs

- 10 ml of Cadmium acetate (5.32 mg/ml) and 1 ml Mercaptosuccinic acid (60 mg/ml) were mixed with 76 ml of deionized water on a magnetic stirrer.
- 1.8 ml of ammonia (1 M) solution was added to it. 1.5 ml of sodium tellurite (221.6 mg/ml) was also added mixed very well. 50 mg of sodium borohydride was added later.
- The solution was stirred for around 2 h until the bubble formation was stopped and subsequently the volume of the solution was made up to 100 ml with deionized water.
- 2 ml of this solution was taken in a small glass vessel and heated at 50 °C, 300 W for 10 min (ramping time 10 min) under microwave irradiation (Multiwave3000, Anton-Paar GmbH, Graz, Austria) and finally the CdTe QDs were prepared and stored in dark at 4 °C.

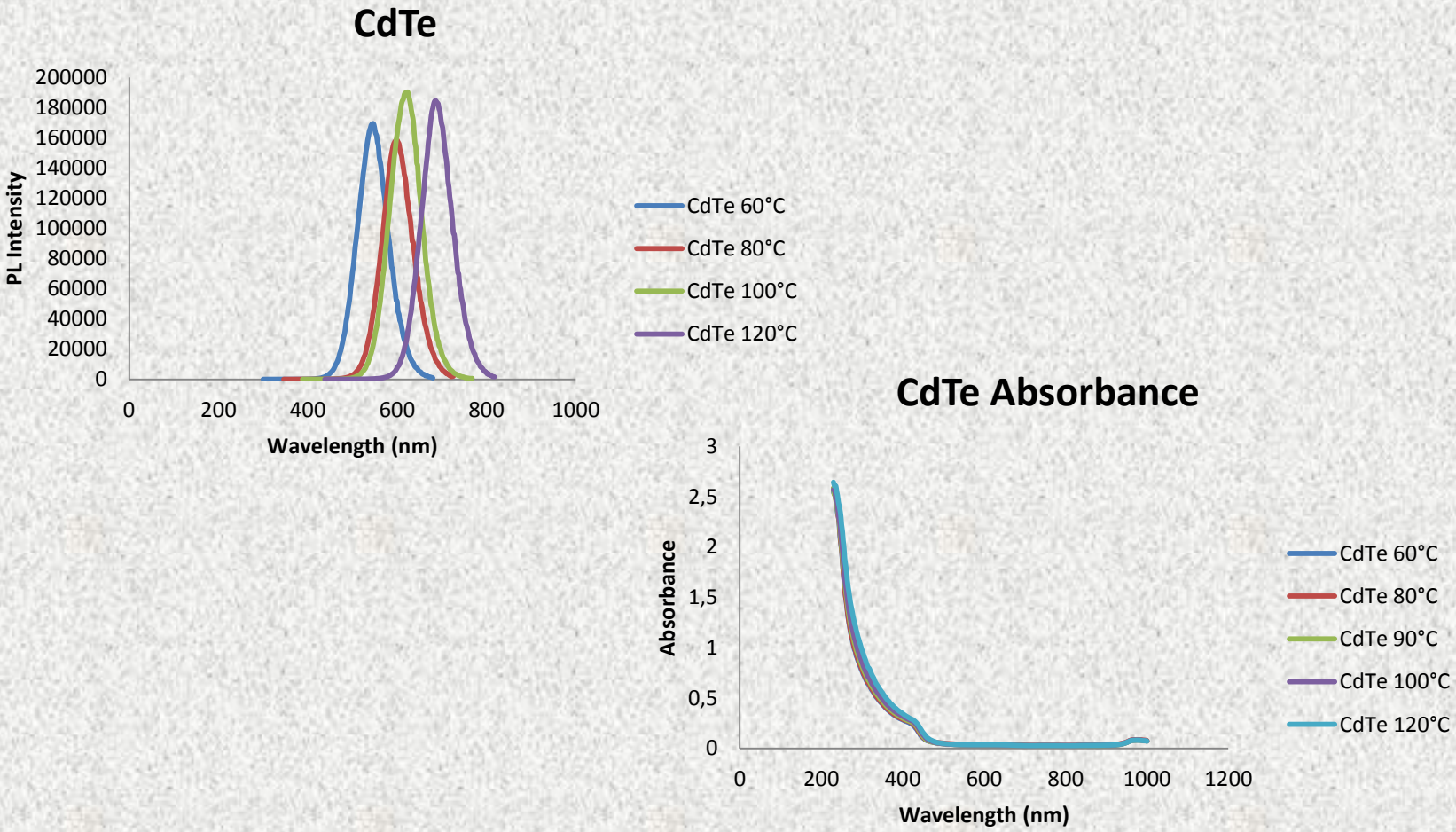
Photo of CdTe QDs under UV (312nm) trans-illumination

r.t. 50°C 60°C 70°C 80°C 90°C 100°C 100°C 110°C 120°C

r.t. ⟶ room temperature



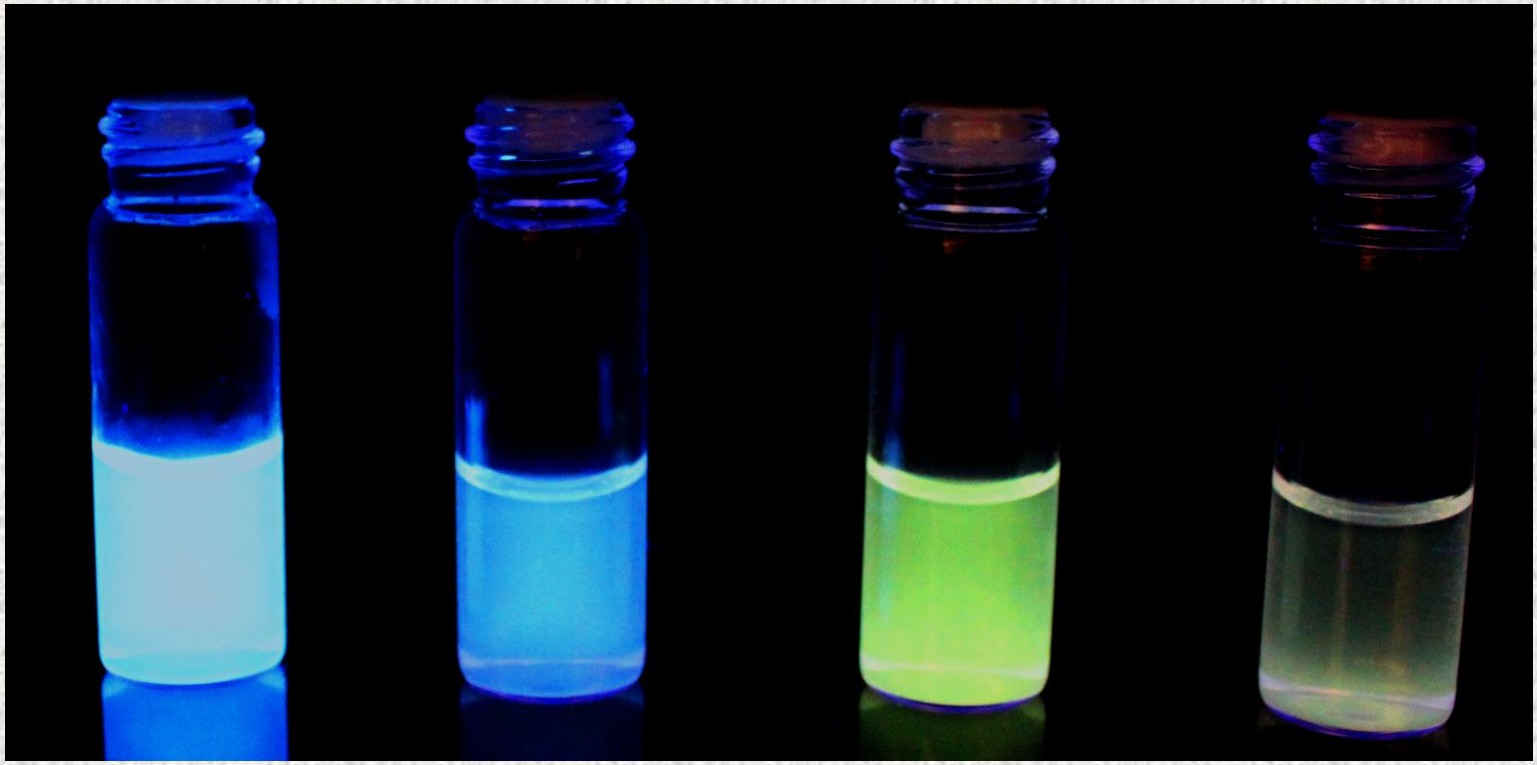
Characterization of CdTe



Preparation of ZnSe QDs

- 1 ml of zinc acetate (43.9 mg/ml) and 1 ml mercaptosuccinic acid (60 mg/ml) were mixed with 85 ml of deionized water on a magnetic stirrer.
- The pH of the solution was made to 7.5 with ammonia (1 M) solution.
- Then 1.5 ml of Sodium selenite (5.26 mg/ml) was added to it and mixed.
- 40 mg of Sodium borohydride was added later.
- The solution was stirred for 2 h until the bubble formation was stopped.
- Finally the volume of the solution was made up to 100 ml with deionized water and the ZnSe QD was prepared and stored in dark at 4 °C.

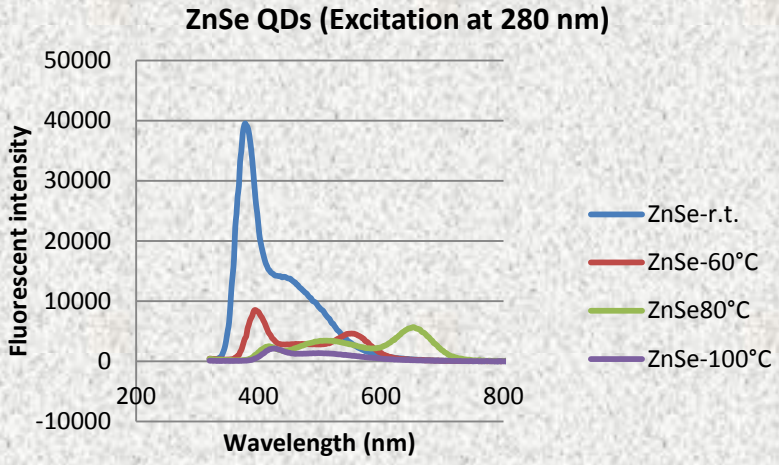
Photo of ZnSe QDs under UV (312nm) trans-illumination

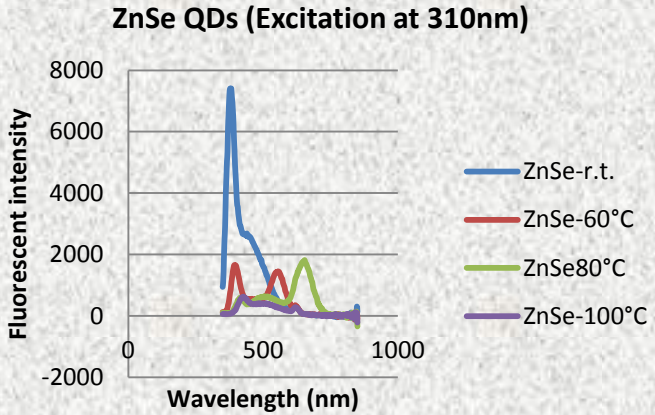


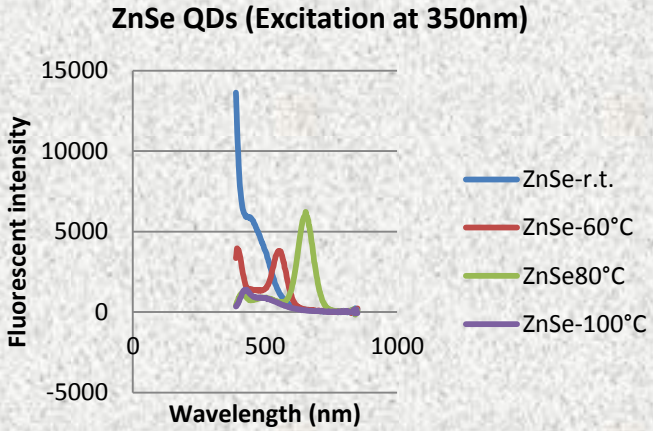
r.t. 60°C 80°C 100°C

r.t. ⟶ room temperature

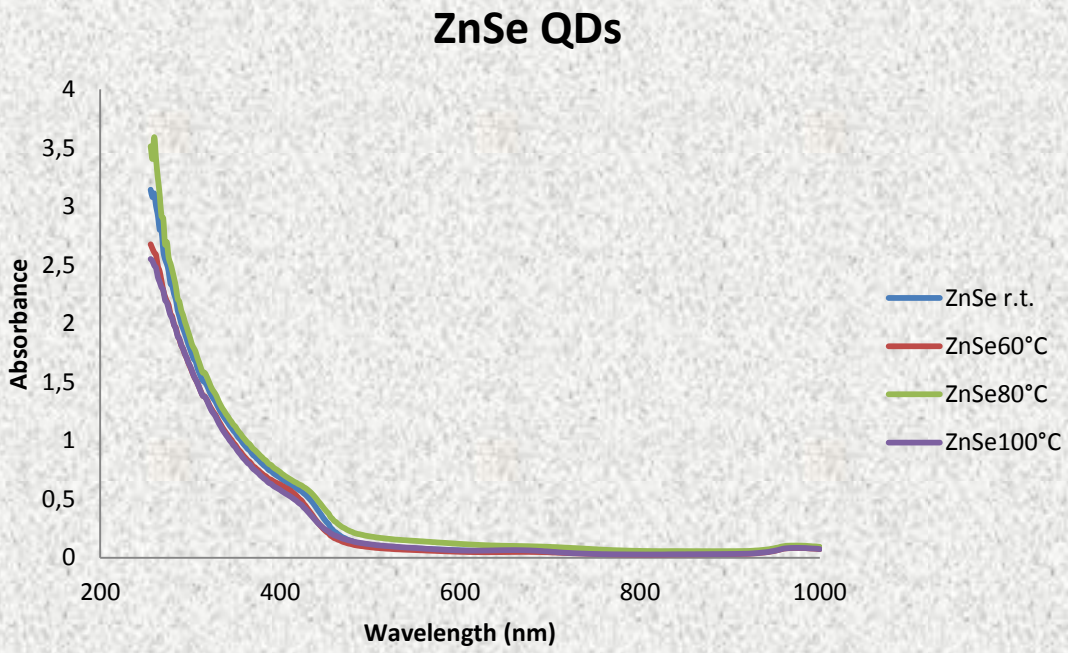
Fluorescent intensity of ZnSe QDs







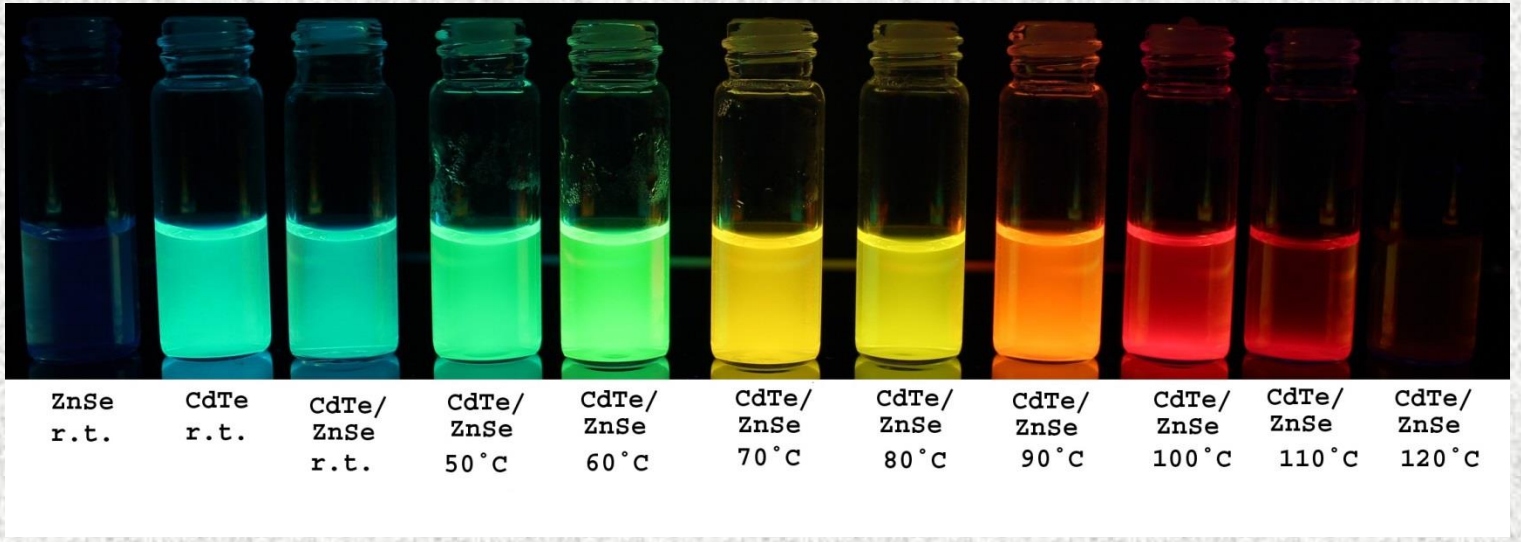
Absorbance of ZnSe QDs



Preparation of ZnSe/CdTe QDs

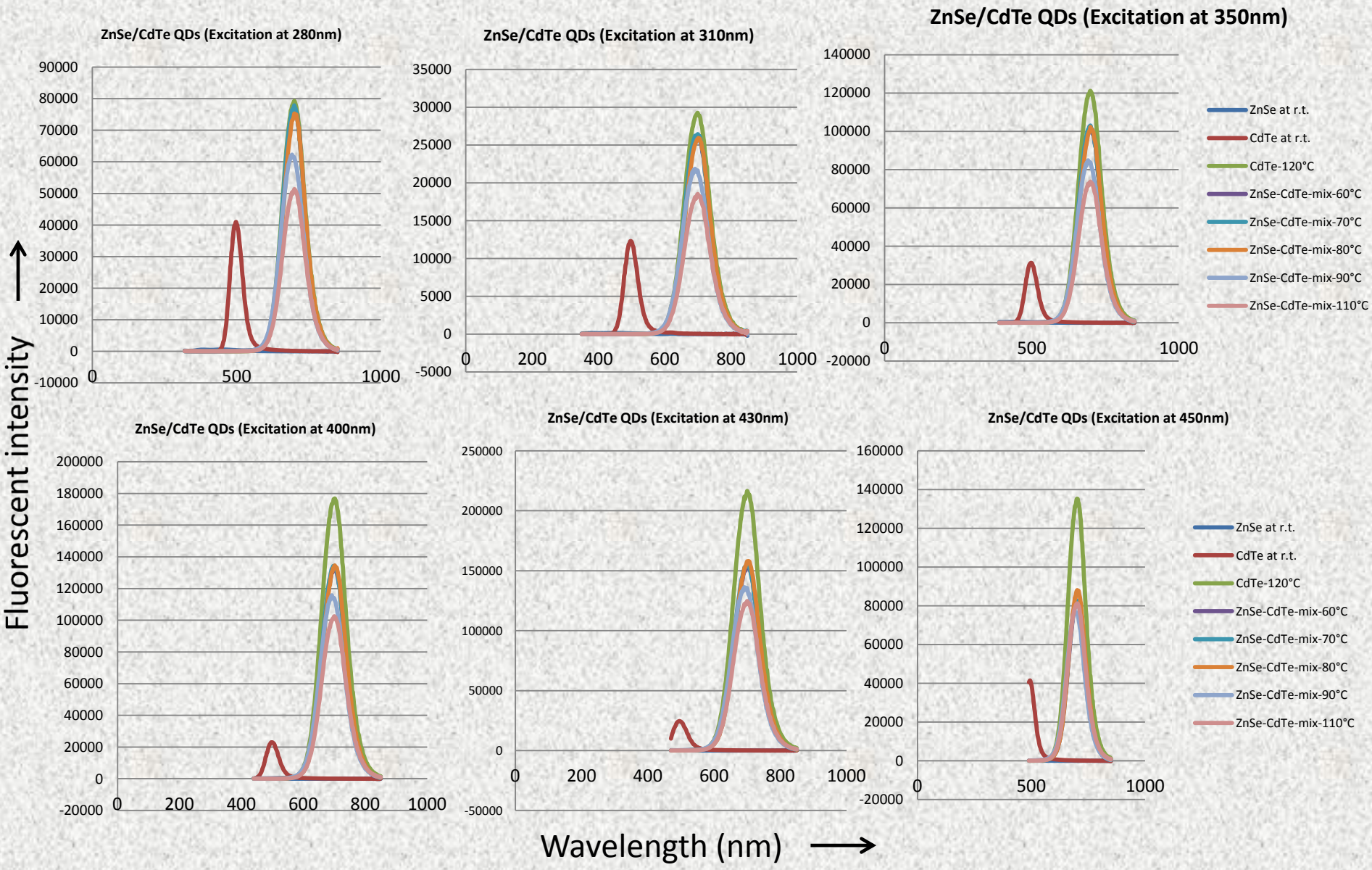
We prepared ZnSe/CdTe QDs by mixing ZnSe QDs with CdTe QDs in an appropriate proportion and heating at different temperature.

Photo of CdTe/ZnSe QDs under UV (312nm) trans-illumination

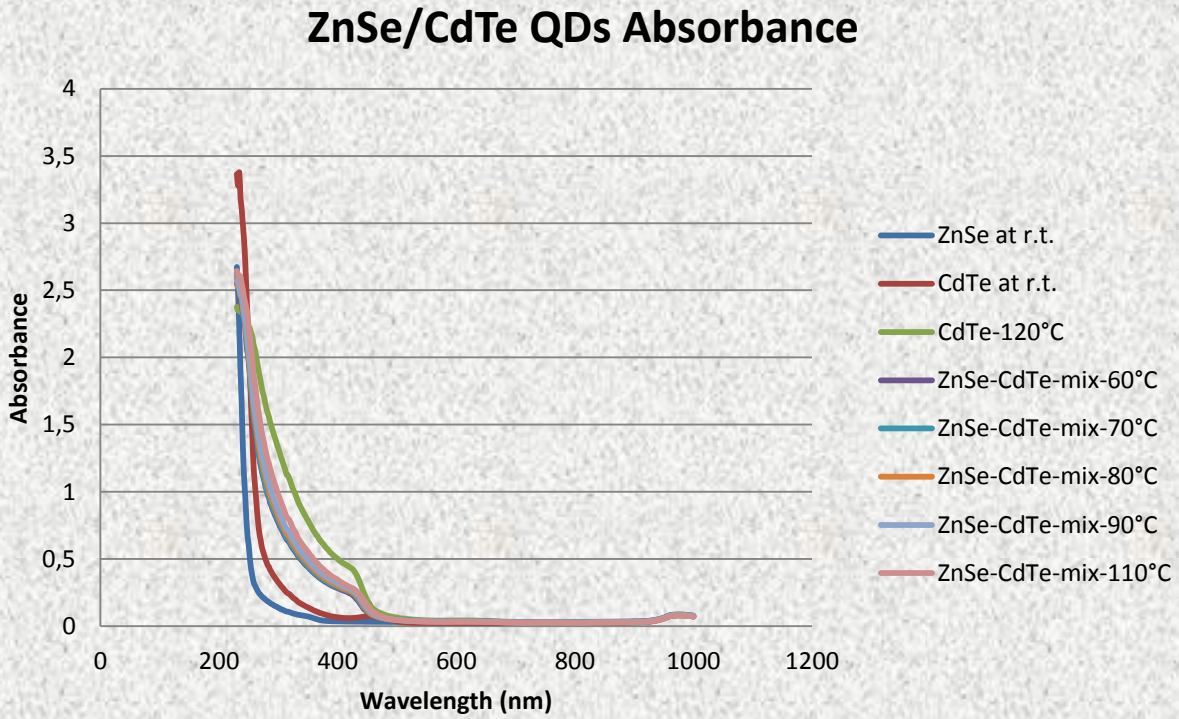


r.t. ⟶ room temperature

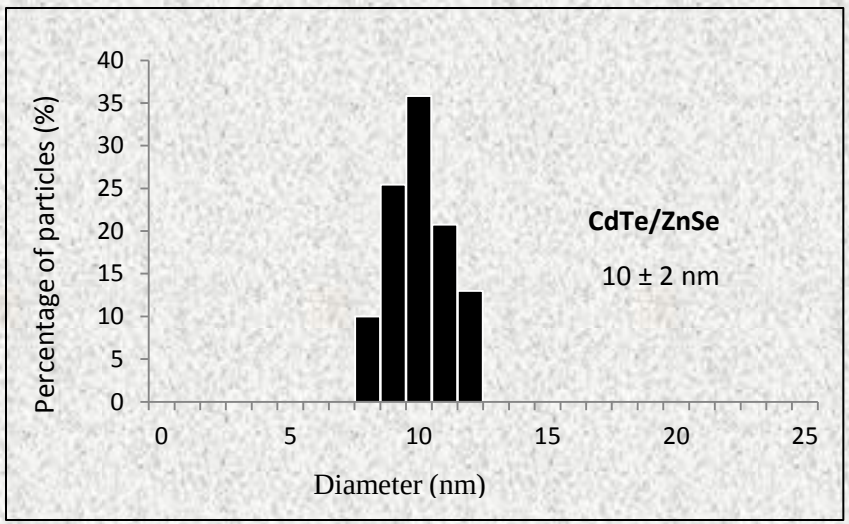
Fluorescent intensity of ZnSe/CdTe QDs

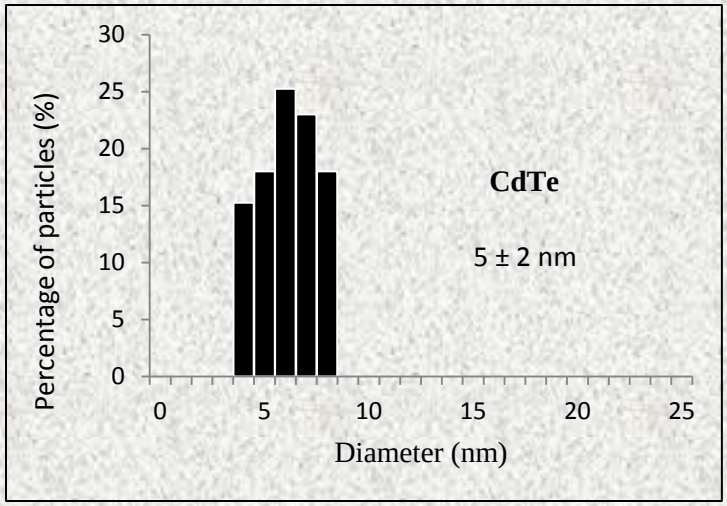


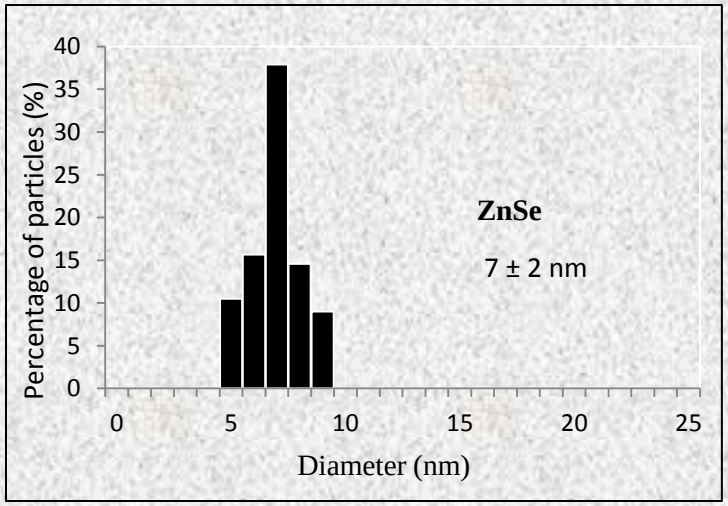
Absorbance of ZnSe/CdTe QDs



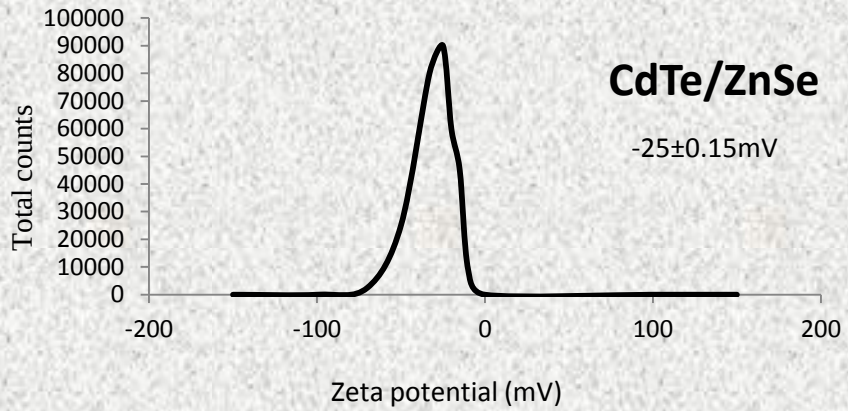
Dynamic Light Scattering (DLS) measurement of ZnSe/CdTe QDs

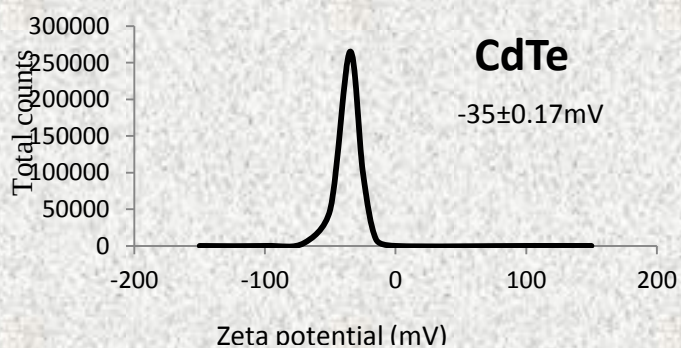


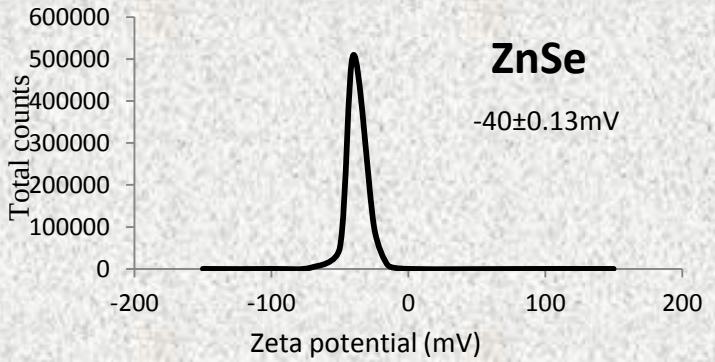




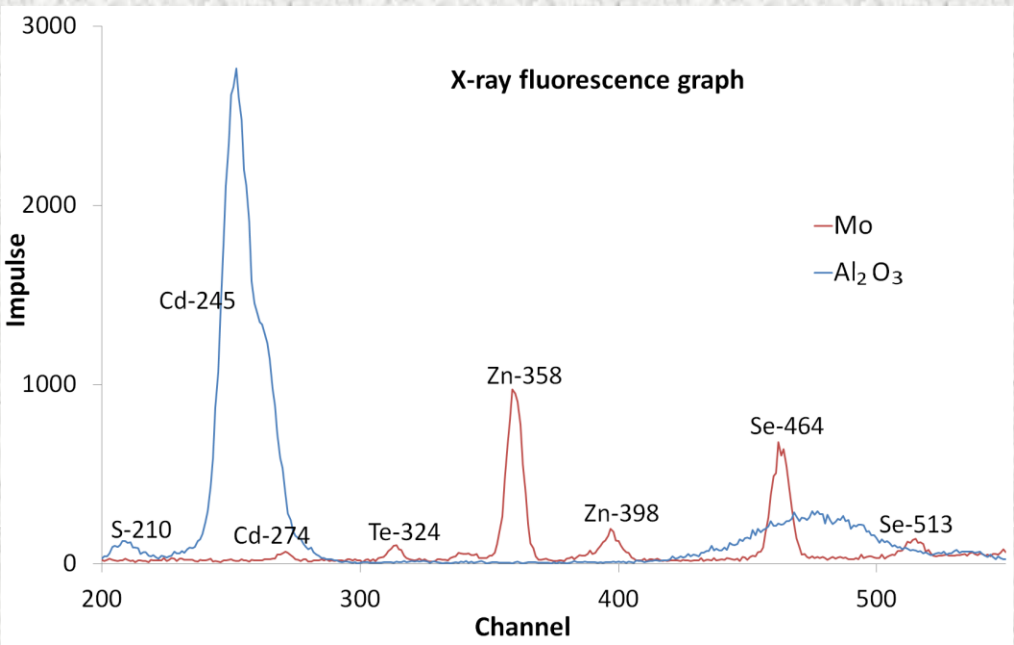
Zetapotential measurement of ZnSe/CdTe QDs



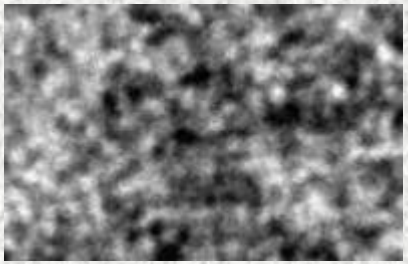




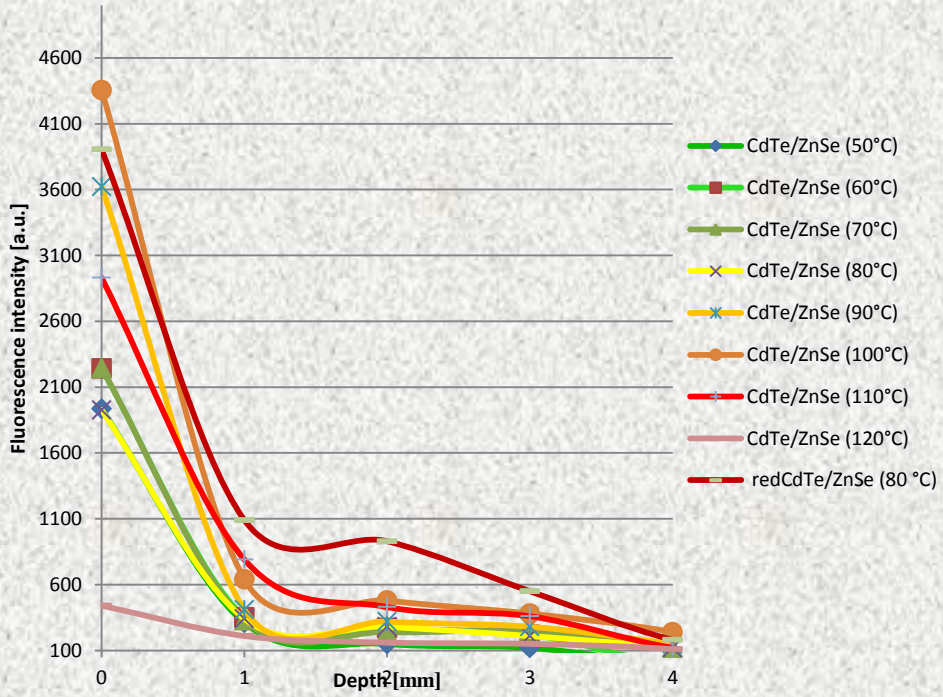
Caharacterization of ZnSe/CdTe QDs



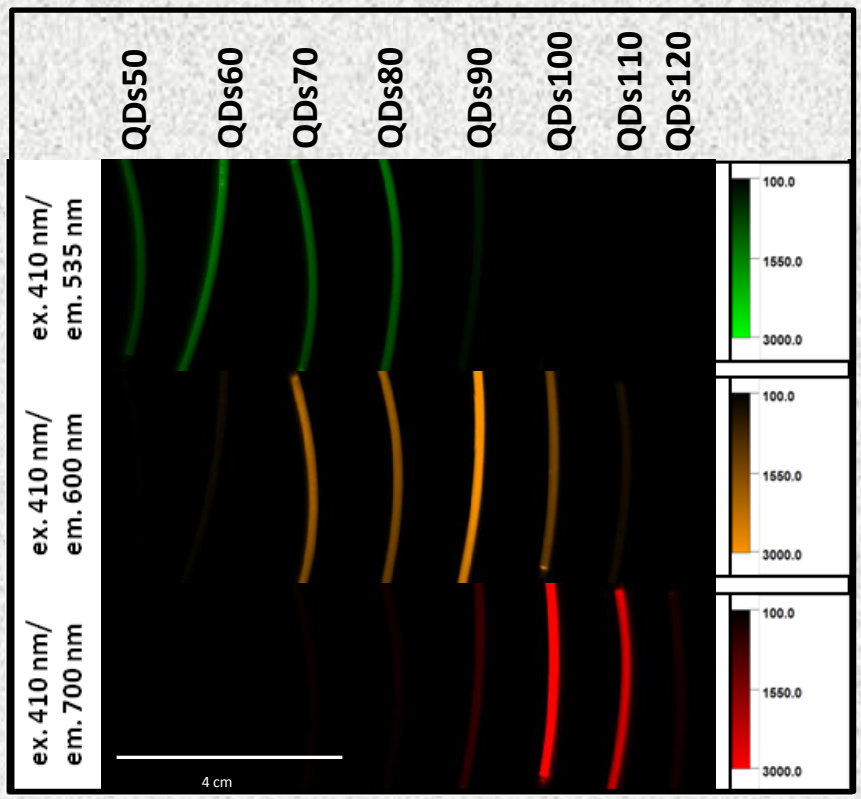
TEM



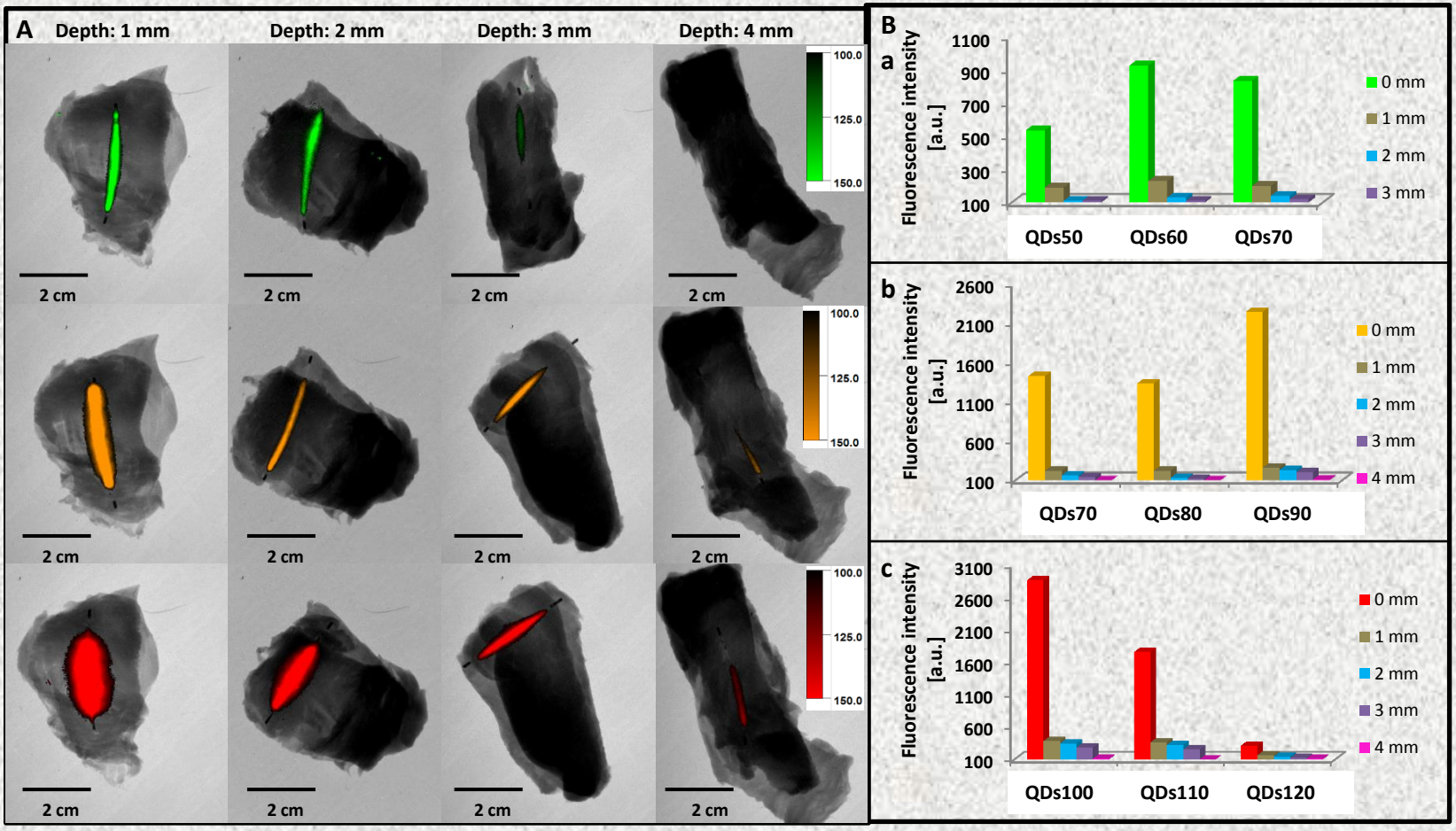
Fluorescence intensity of CdTe/ZnSe QDs in the different depths in the tissue (in tube)

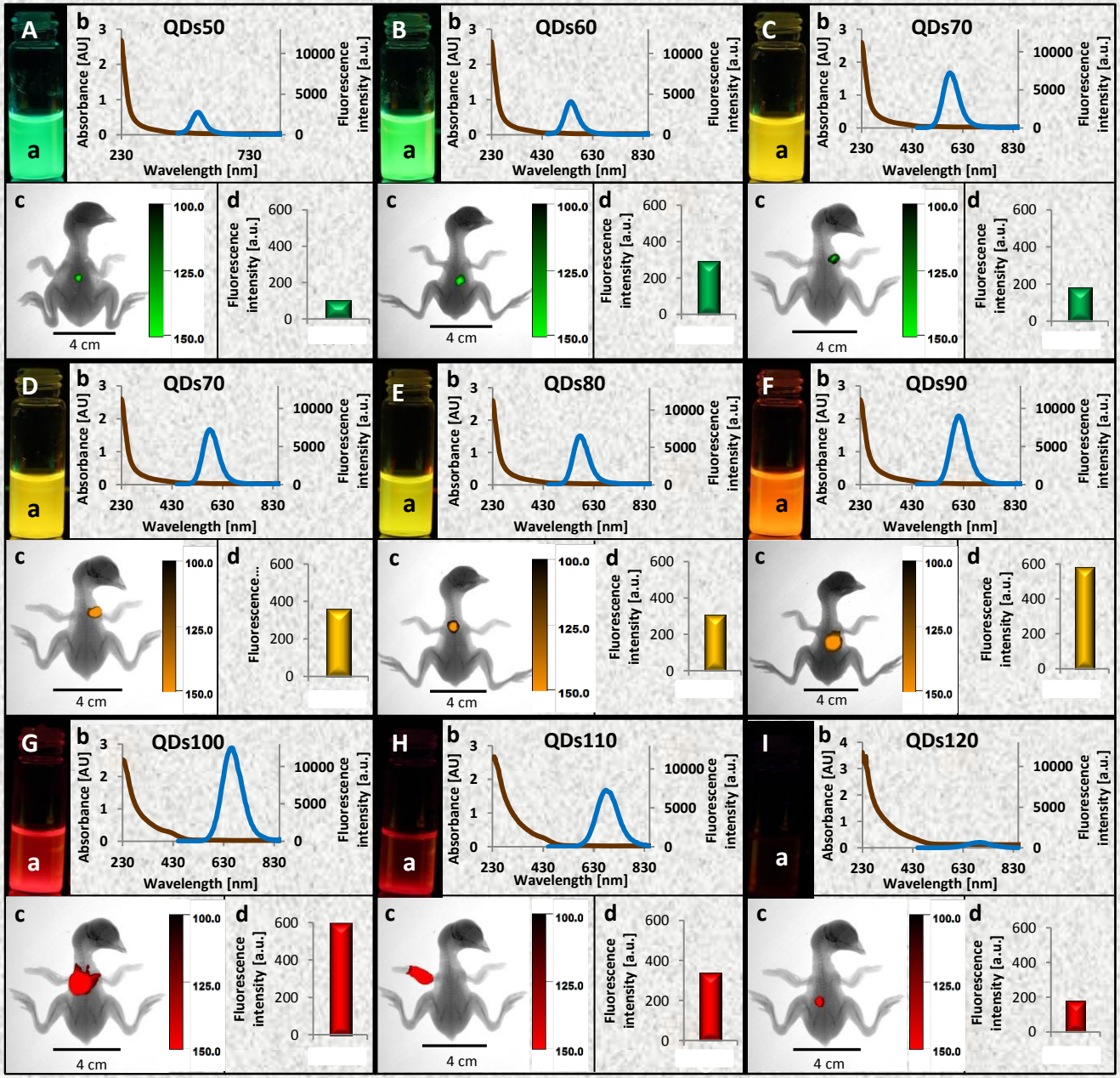


Fluorescence intensity of QDs (CdTe/ZnSe) enclosed into the capillaries measured by Carestream Molecular Imaging Software (Rochester, NY, USA). All QDs detected by different emission filters (535 nm, 600 nm, 700 nm), excitation: 410 nm.



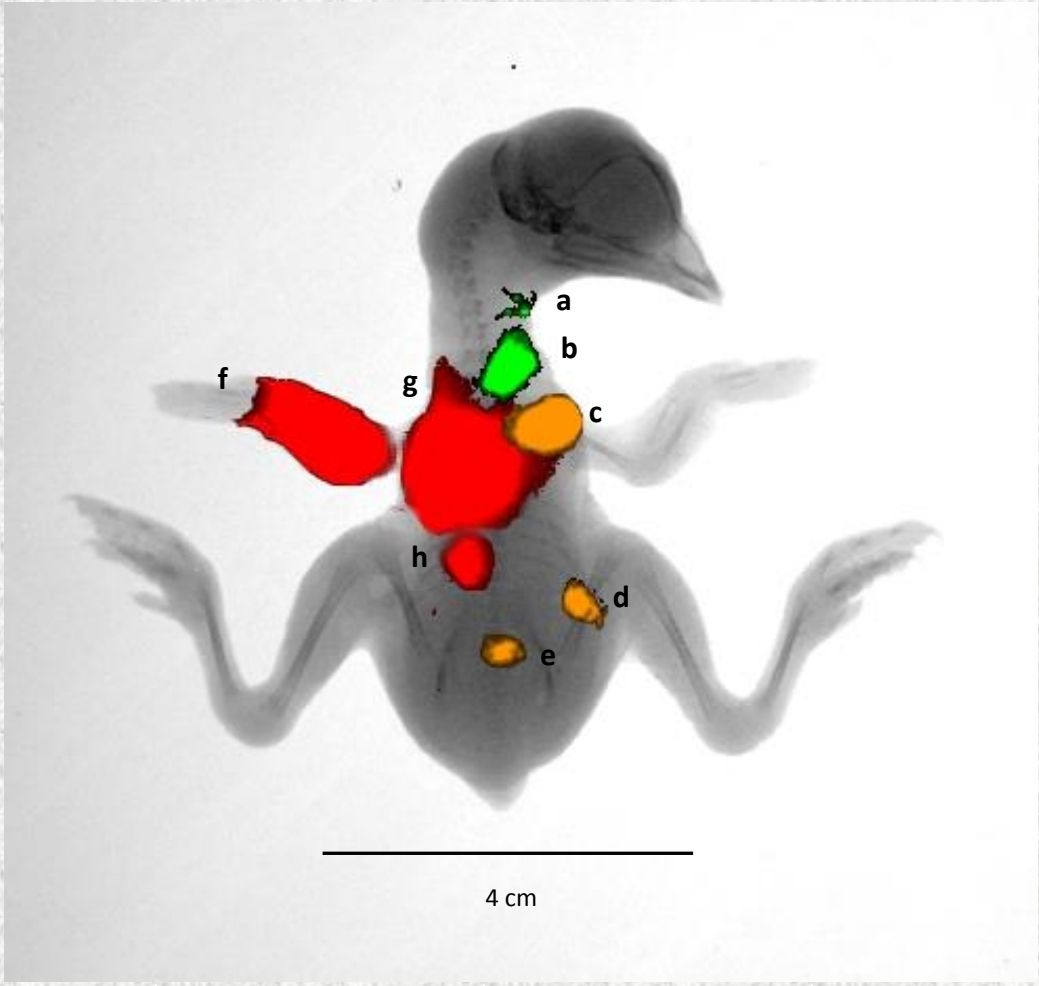
(A) Detection of the QDs in the capillaries in the different depths in the chicken breast muscle tissue: a) QDs 60 °C, b) QDs 90 °C, c) QDs 100 °C. (B) Quantification of the fluorescence intensity of different QDs: a - excitation: 410 nm, emission: 535 nm, b - excitation: 410 nm, emission: 600 nm, c - excitation: 410 nm, emission: 700 nm, background: 100 a.u. Fluorescence intensity of QDs (CdTe/ZnSe) enclosed into the capillaries measured by Carestream Molecular Imaging Software (Rochester, NY, USA).





Fluorescence of different QDs (CdTe/ZnSe): a – fluorescent images of QDs (UV 312 nm); b – absorbance (brown line) and fluorescence (blue line) spectrum of QDs; c – fluorescent images of QDs in chicken embryo (25 µl under the skin). Excitation wavelength: 410 nm, emission wavelength: 535 nm (QDs50 –70°C), 600 nm (QDs70 –90°C), 700 nm (QDs100 –120°C); d – fluorescence intensity of quantum dots in the embryo body.

All QDs (CdTe/ZnSe°C) were applied into the chicken embryo (25 µl under the skin): a - QDs 50°C, b – QDs 60°C, c – QDs 70°C, d – QDs 80°C, e – QDs 90°C, f – QDs 100°C, g – QDs 110°C and h – QDs 120°C. Detected by Carestream Molecular Imaging Software (Rochester, NY, USA). The fluorescence and the X-ray images were overlaid by PhotoFiltre Studio X.



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