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

Název: # Interaction of metallothionein with CdTe quantum dots studied by electrochemistry

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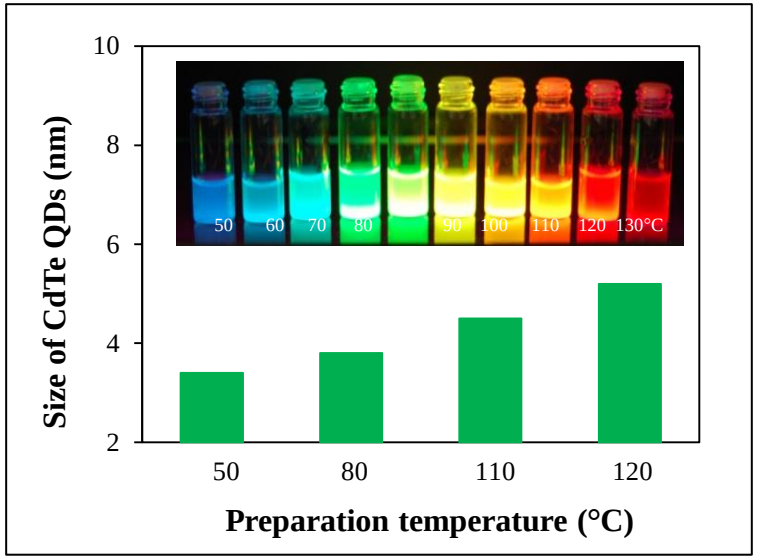
Název projektu: Mezinárodní spolupráce v oblasti "in vivo" zobrazovacích technik

Quantum dots

- single crystals with nanometers in diameter (2 – 10 nm)
- excellent optical properties (high photoluminescence quantum yield, strong photostability, wide absorption yield coupled with narrow emission, fluorescent and semiconductor properties)
- sizes and shapes - control by temperature, duration and type of ligand molecules applied during the synthetic processes
- the applications: chemistry, chemical biology and biomedicine, gene technology, tumour biology investigation, and fluorescent labelling of cellular proteins



Metallothioneins

- small cysteine-rich proteins
- able to bind up to 20 monovalent and up to 7 divalent heavy metal ions
- tertiary structure of metallothionein - two domains easily form cysteine clusters to bind metal ions
- function of MTs: - the regulation of zinc homeostasis
  - cells detoxification from heavy metals
  - protection of cells to oxidative stress

Aim

- interaction between MT2A and different size of MSA-capped CdTe QDs

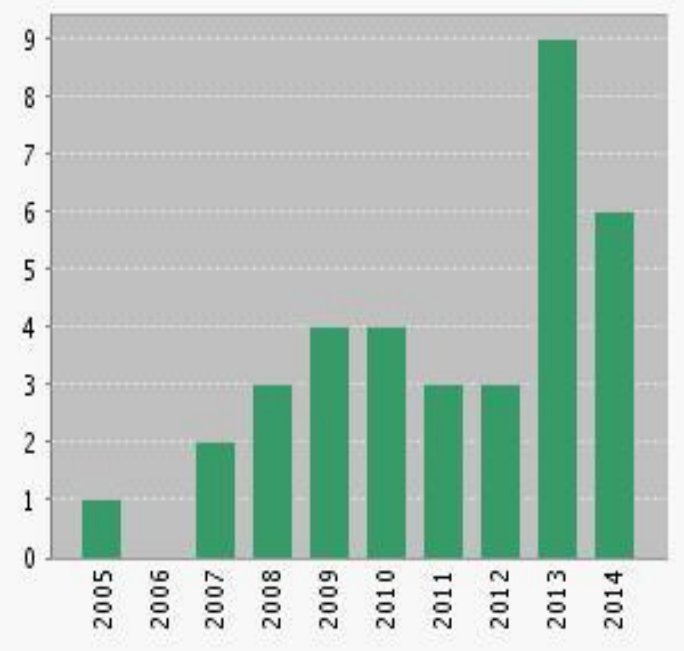
Backround

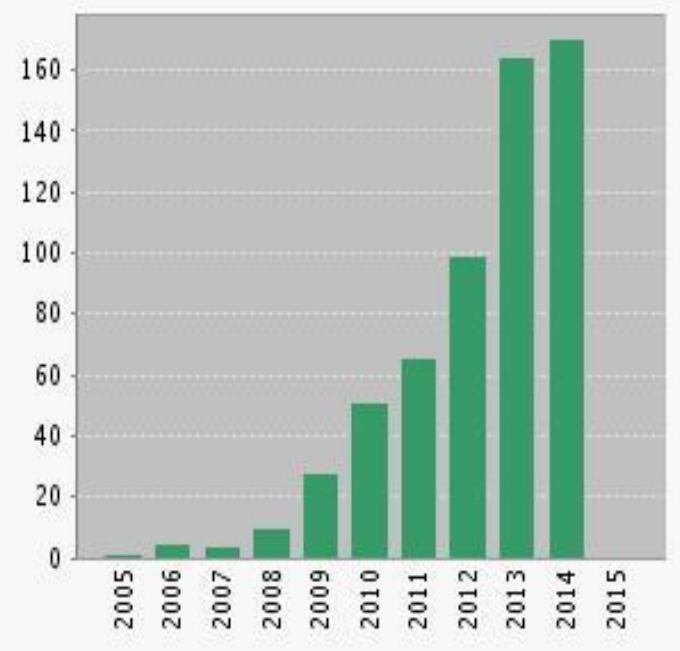
Huang et al. (2011) - various capped CdS quantum dots (mercaptoethanol , l-cysteine and glutathione, found various affinity to the proteins (bovine serum albumin and lysozyme ; GSH-capped CdS QDs - the weakest interaction with BSA and LZY, MPA-capped CdS QDs the strongest.

Wang et al. (2012) - Similar experiment using CdTe QDs capped with the same way show the same results in general.

Lu et al. (2011) - description of interaction between CdTe QDs and proteins; interactions have electrostatic attraction nature mainly

Topic: metallothionein
Topic: quantum dots





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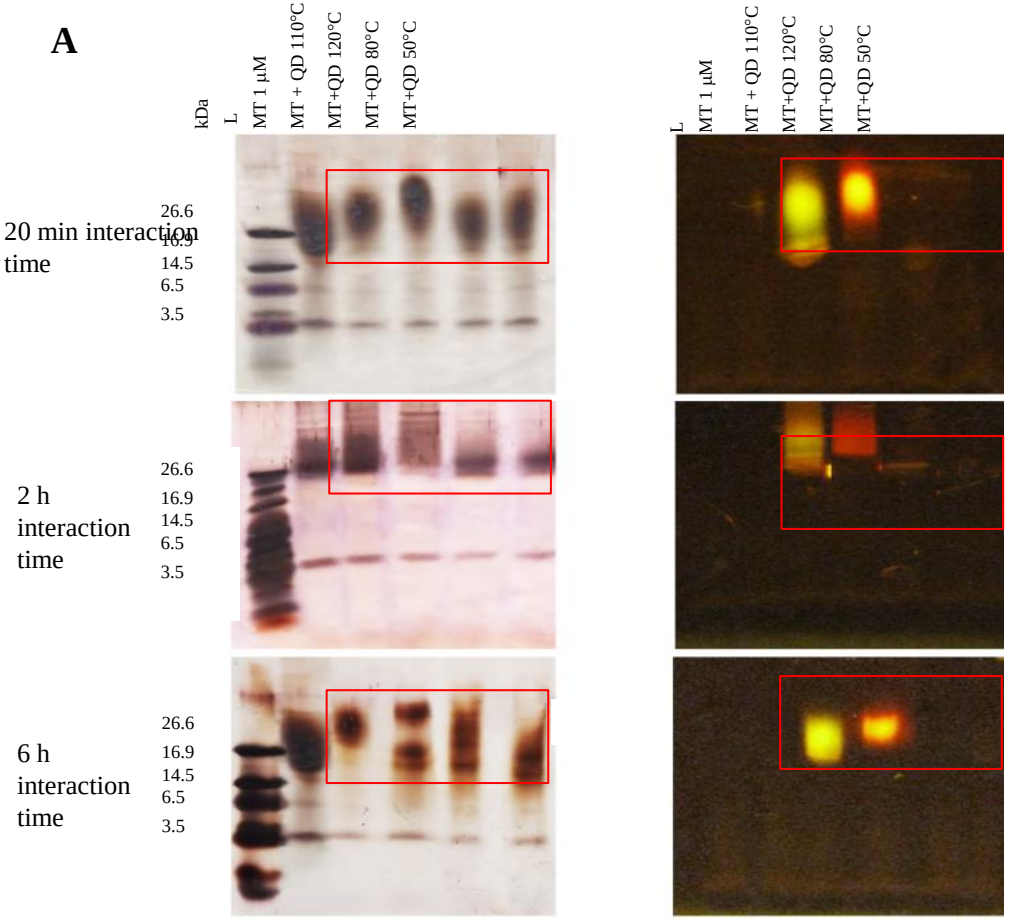
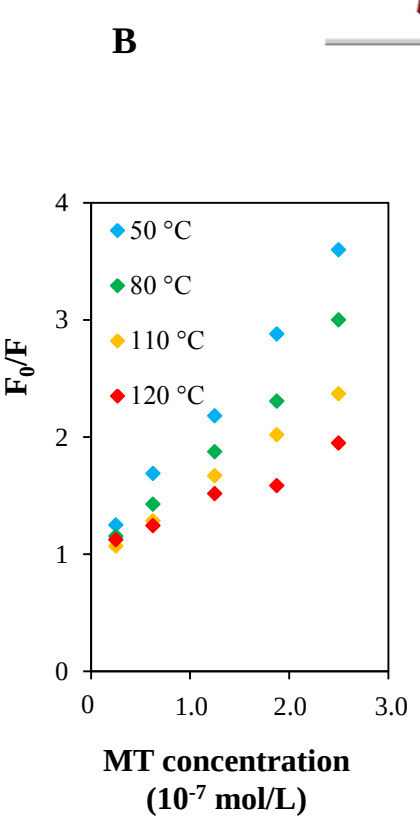
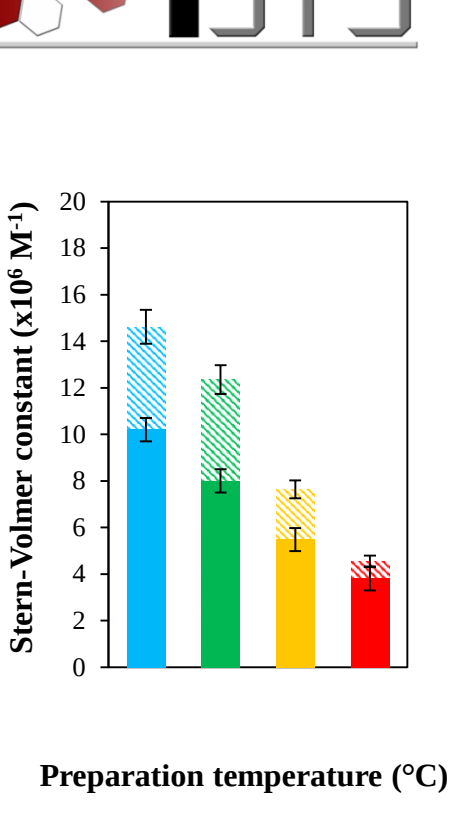
Interaction MT with QDs



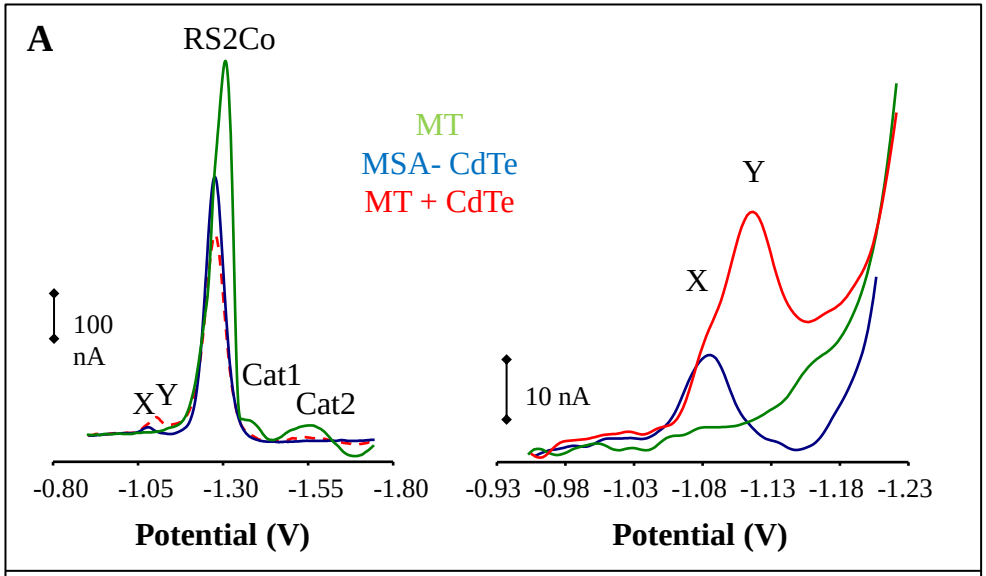




(**A**) Tris-tricine gel electrophoresis, the interaction of MT (1µM) with MSA-capped CdTe QDs (500 µM), 1:1, interaction time 20 min, 2 and 6 h; used MSA-capped CdTe QDs according to size : 120°C > 80 °C > 110 °C > 50 °C.

(**B**) Dependence of F_0/F to various concentration of MT (0.05×10^{-8} – 2.50×10^{-7} mol/l) with MSA-capped CdTe QDs (500 µM), 1:1, interaction time 0 s. The dependence of Stern-Volmer plot of various sized CdTe quenched by metallothionein for two temperatures 25°C and 50°C.

Interaction MT with QDs



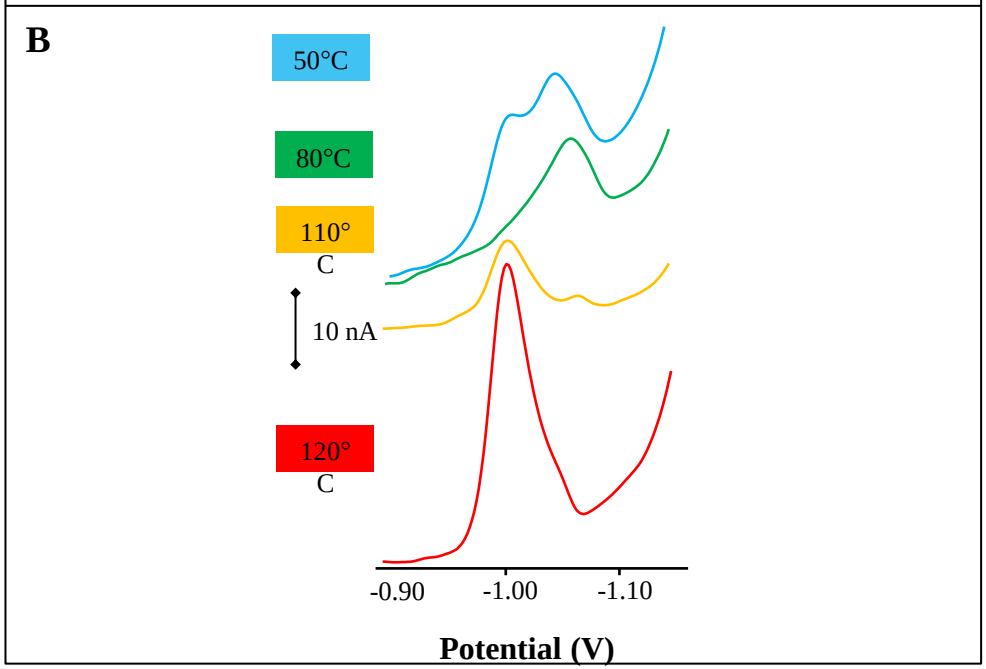


Figure. (**A**) Voltammograms of MT (green line), 50°C MSA-capped CdTe QDs (blue line) and mixture of MT with 50°C MSA-capped CdTe QDs (red line). Detail of peaks X (-1.08V) and Y (-1.11 V) for MT (green line), 50°C MSA-capped CdTe QDs (blue line) and mixture of MT with MSA-capped CdTe QDs (red line).

(**B**) Voltammograms of various sized MSA-capped CdTe QDs with MT on HMDE (MT 1mM, 500 µM MSA-capped CdTe QDs, 1:1).

Interaction MT with QDs

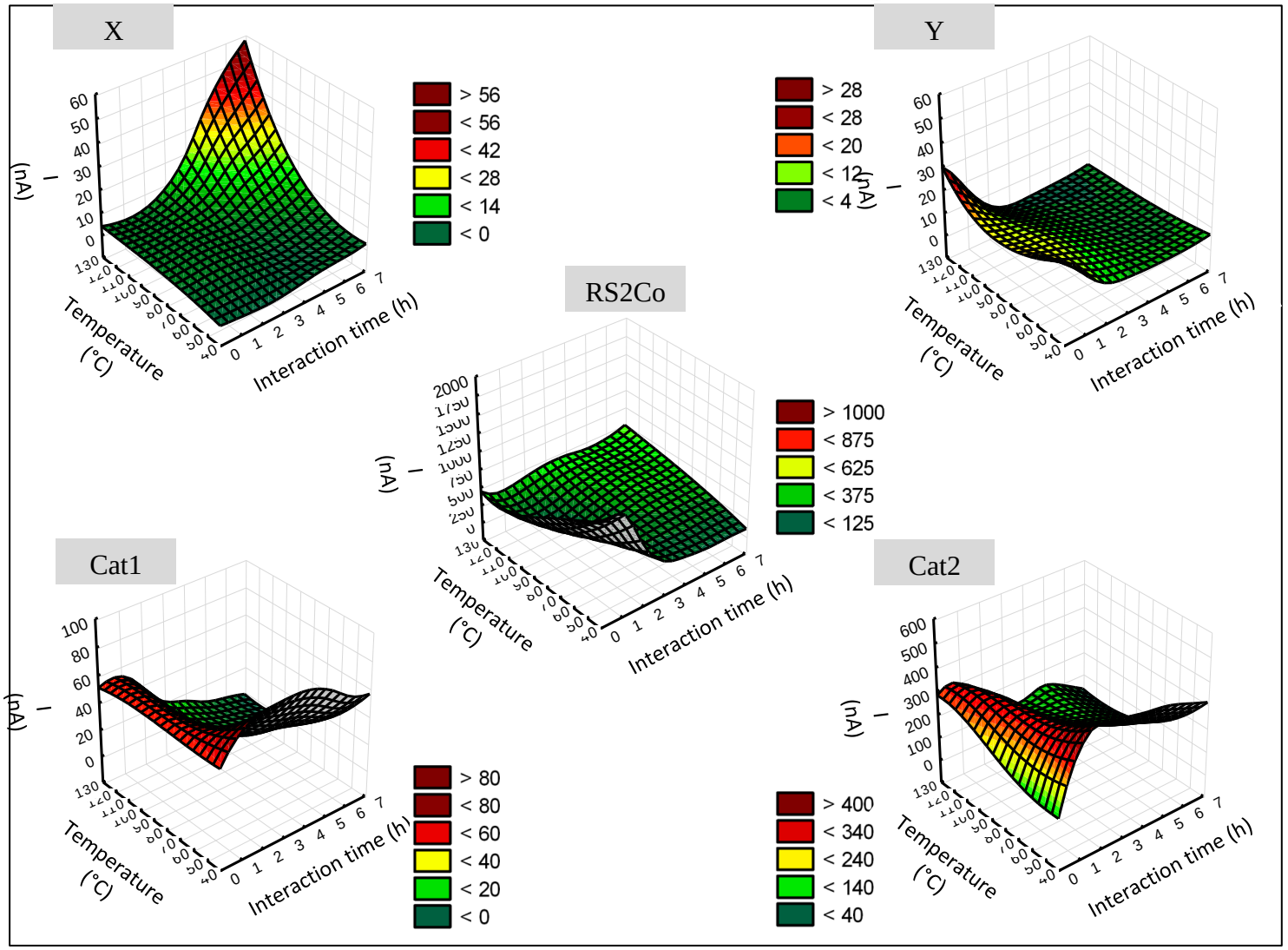
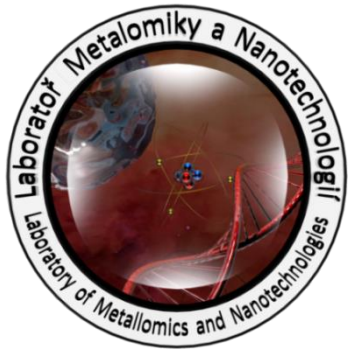


Figure. Dependence of individual peaks height (X, Y, RS2Co, Cat1 and Cat2) on temperature and interaction time. Experiments were done in Brdicka electrolyte. Interaction time 0 s - 360 min.

Conclusion

- our study showed that QDs size had a strong influence to interaction between QDs and MT and the smallest QDs had the highest affinity to MT;
- study of MT and MSA-capped CdTe QDs showed that MT and MSA-capped CdTe QDs doesn´t create stabile stable complex but some interaction between components is evident;
- because of MT is able to create tetra-hexamers and accordance to correlation between sizes of MT (MT-mers) and applied QDs, probably it could be concluded that structural effects are critical for creation of interaction between MT and MSA-capped CdTe QDs;
- result confirms that not only electrostatic but structural effects are important for interaction of proteins and QDs.

Thank you for your attention!



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