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

Název:

CdTe quantum dots and thier electrochemical properties

Školitel: Kateřina Tmejová

Datum: 25.10.2013

Reg.č.projektu: CZ.1.07/2.4.00/31.0023

Název projektu: Partnerská síť centra excelentního bionanotechnologického výzkumu

NanoBioMetalNet

QUANTUM DOTS

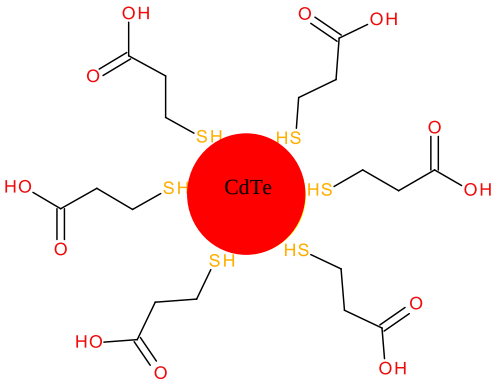
- semiconductor nanocrystals - small enough to exhibit size-dependent properties ; their sizes and shapes are possible to precisely controlled by temperature, duration and ligand molecules during the synthetic processes.

- have generated tremendous interest due to their unique optical properties including broad excitation spectra
- narrow, tuneable and symmetric emission spectra covering the wide range of spectra from visible to infrared, excellent photostability

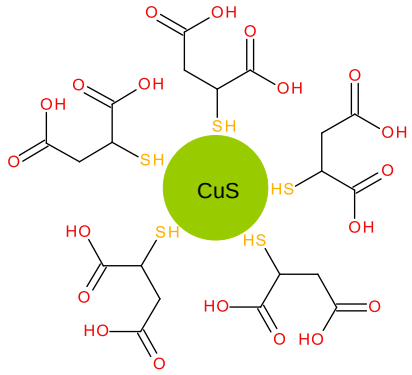
- one of the most promising nanomaterial for biological staining, detection of bio-macromolecules and immunohistochemistry

STRUCTURE OF QUANTUM DOTS

- The most popular types of QDs include CdTe, CdSe, ZnSe, and ZnS; however, metals, such as In, Ga, and many others also can be used.
- Our QDs: CdTe, PbS, CuS, CdS, ZnS ……, modified by MPA, MSA.



CdTe MPA



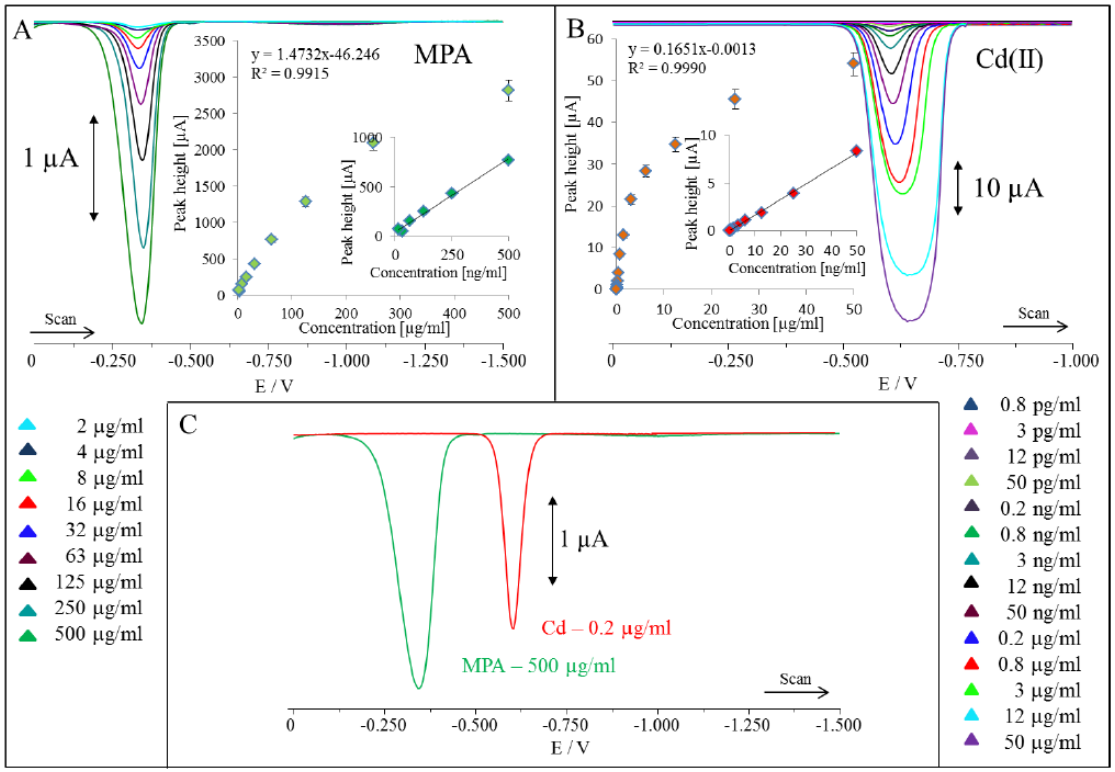
CuS MSA

ELECTROCHEMICAL DETECTION

- AUTOLAB Analyzer connected to VA-Stand 663
- A standard cell with three electrodes: working electrode - a hanging mercury drop electrode (HMDE), reference electrode - Ag/AgCl/3 M KCl electrode, auxiliary electrode - graphite electrode.
- Acetate buffer (0.2 M, pH 5.0) such as electrolyte.

- Parameters for differential pulse voltammetric (DPV): start potential −1.5 V; end potential 0 V; modulation time 0.057 s, time interval 0.2 s, step potential of 1.05 mV/s, modulation amplitude of 250 mV, Eads = 0 V. All experiments were carried out at room temperature (20 °C). The DPV samples analyzed were deoxygenated prior to measurements by purging with argon (99.999%) saturated with water for 120 s.

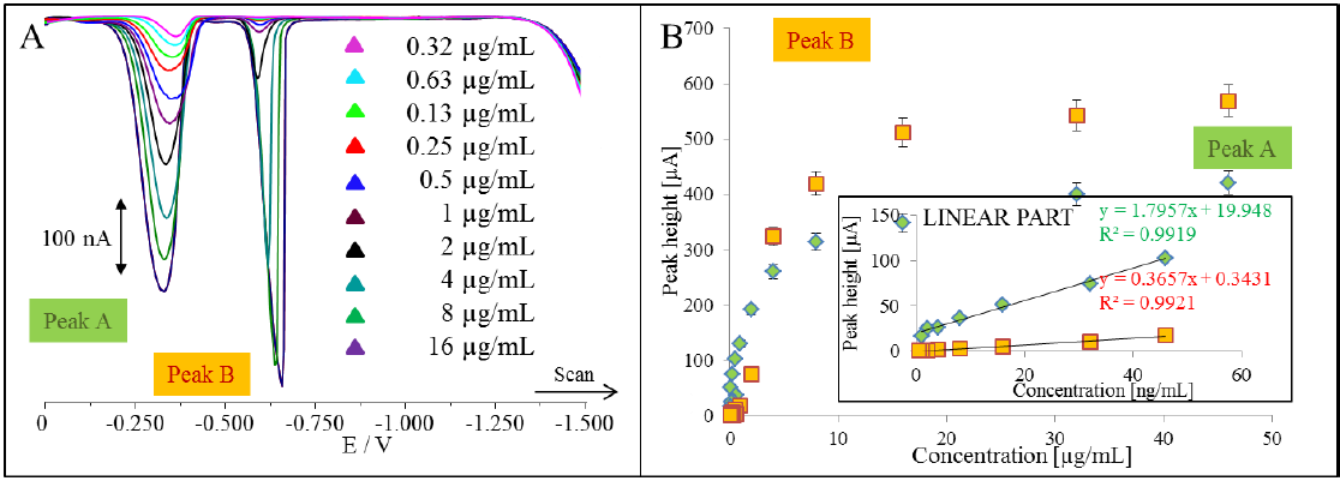
Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.



RESULTS - studying of the basic electrochemical behaviour of MPA and cadmium, as the components of our QDs

- fig. A: MPA peaks at −0.35 V
- inset in fig. 1A.: the peak of MPA was proportional to its concentration
- fig. B: Cd peaks at −0.60 V
- inset in figure 1B: Peaks are well developed and also proportional to Cd(II) concentrations up to 50 µg/mL
- fig C: the plot of MPA and cadmium(II) ions peaks.

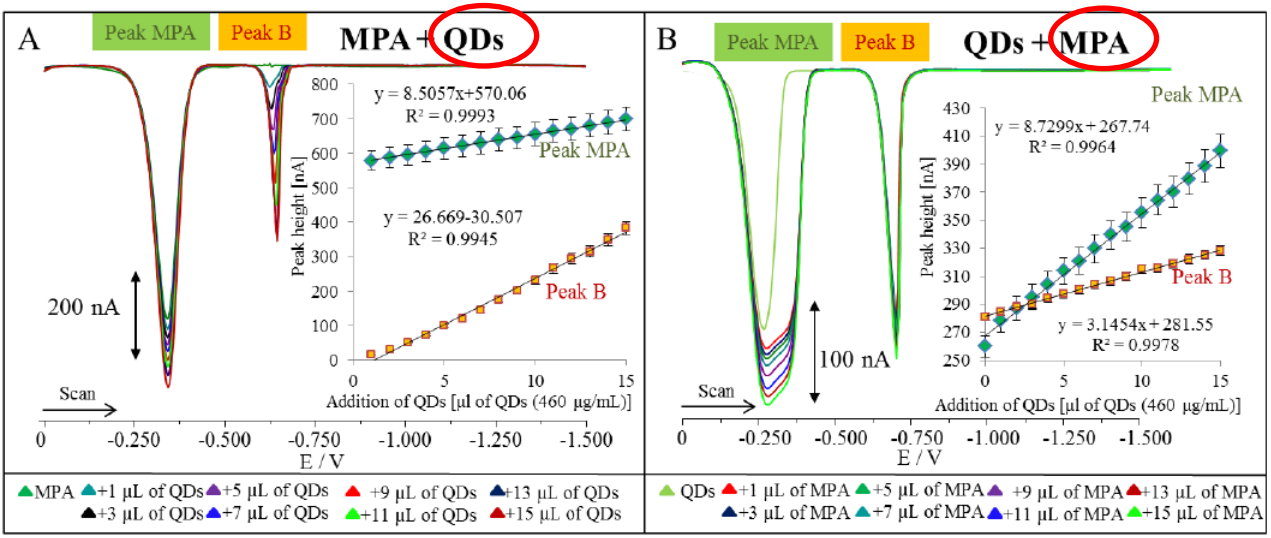
Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.



RESULTS - studying of QDs

- DP voltammetry of CdTe QDs. fig. A Typical DP voltammograms of various concentrations of QDs
- fig. B: Dependences of peaks A and B heights on the concentration of QDs. In insert: linear part of dependence of peak A and B heights on the concentration of QDs.

Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.

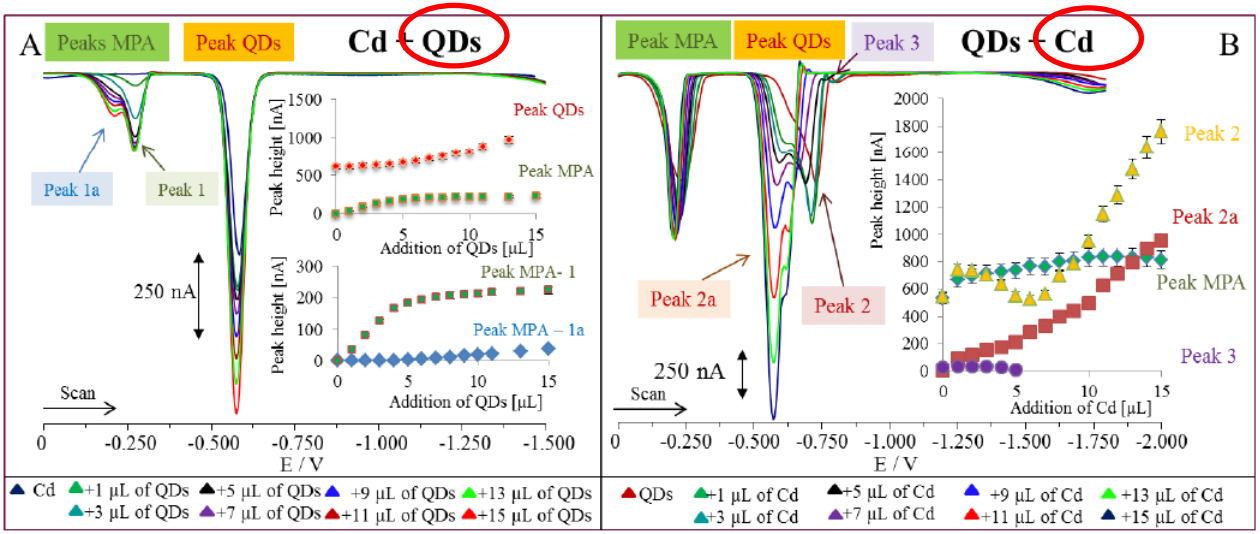


RESULTS - studying of QDs addition of QDs-A/ MPA-B

- Fig. A: DP voltammograms of MPA (500 µg/mL) with additions of QDs in various volumes (460 µg/mL, quantified according to concentration of Cd(II)); in inset: dependence of MPA and B peak heights on concentration of QDs
- Fig. B: DP voltammograms of QDs (460 µg/mL) with additions of MPA in various volumes (500 µg/mL); in inset: dependence of MPA and B peak heights on concentration of MPA.

Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.

RESULTS - studying of QDs addition of QDs-A/ Cd-B



- Fig. A: DP voltammograms of Cd(II) (500 µg/mL) with additions of QDs in various volumes (460 µg/mL, quantified according to concentration of cadmium(II)); in inset: dependence of MPA (peak 1 and 1a) and QDs peak heights on concentration of QDs

- Fig. B: DP voltammograms of QDs (460 µg/mL) with additions of Cd(II) in various volumes (500 µg/mL); in inset: dependence of MPA and QDs peaks (peak 2, 2a, and 3) heights on concentration of Cd(II). Peak 2a is of QDs origin, peak 2 is some MPA-QDs-Cd(II) complexes after the excess of Cd (II)

Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.

CONCLUSION

- Electrochemical characterisation of CdTe and its components.
- The differential pulse voltammetry can be considered as extremely sensitive and a low cost method for the rapid characterization of quantum dots.
- With LOD down to fg per mL, quantum dots should be of interest also as an electroactive label.

Published by SOBROVA, P.; RYVOLOVA, M.; HUBALEK, J.; ADAM, V.; KIZEK, R. Voltammetry as a Tool for Characterization of CdTe Quantum Dots. *International Journal of Molecular Sciences*, 2013, roč. 14. č. 7, s. 13497-13510.

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

THANK YOU FOR YOUR ATTENTION

AND

NanoBioMetalNet CZ.1.07/2.4.00/31.0023

25. 10. 2013, Brno. Czech Republic, EU

Reg.č.projektu: CZ.1.07/2.4.00/31.0023

Název projektu: Partnerská síť centra excelentního bionanotechnologického výzkumu

NanoBioMetalNet