

Adsorption equilibrium, kinetics and thermodynamics of CdTe quantum dots with distinct cappings using different solid supports

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Abstract

Semiconductor nanocrystals, or quantum dots (QDs) have been used, during the last decade, as bioimaging tools with great potential to definite chemosensors with different applications [1]. In order to improve the applicability of these nanomaterials in chemosensors, the immobilization of quantum dots onto solid supports has been used [2]. The immobilization enables multiple or repetitive uses and when compared with the consecutive utilization of successive batches, it allows a more sustainable and rational utilization. In addition, the immobilization assures a more cost-effective operation, minimization of reagent consumption and waste production. It also allows stable measurements and consequently reproducible analytical signals.

In this work we have evaluated distinct strategies to carry out the immobilization of QDs onto solid supports (Figure 1). It was studied solid supports with distinct characteristics and it was evaluated the influence of QDs capping and size, concentration, pH, temperature, contact time between the solid and the QDs (Figure 2), etc.

Adsorption equilibrium was established and the maximum adsorption of QD on the solid support was evaluated. In order to analyze the equilibrium data, Freundlich and Langmuir isotherms were used and kinetic data were fitted to the pseudo-first-order and pseudo-second-order models. It was also calculated different thermodynamic parameters as Gibbs free energy, enthalpy and entropy and the stability of immobilized QDs was confirmed.

References

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Acknowledgments

This work received financial support from the European Union (FEDER funds through COMPETE) and National Funds (FCT, Fundação para a Ciência e Tecnologia) through project Pest-C/EQB/LA0006/2013. The work also received financial support from the European Union (FEDER funds) under the framework of QREN through Project NORTE-07-0124-FEDER-000067. Marieta L. C. Passos thanks FCT, Pos-doc grant (SFRH/BPD/72378/2010). S. Sofia M. Rodrigues thanks FCT and FSE for the Ph.D. Grant (SFRH/BD/70444/2010).

Figures

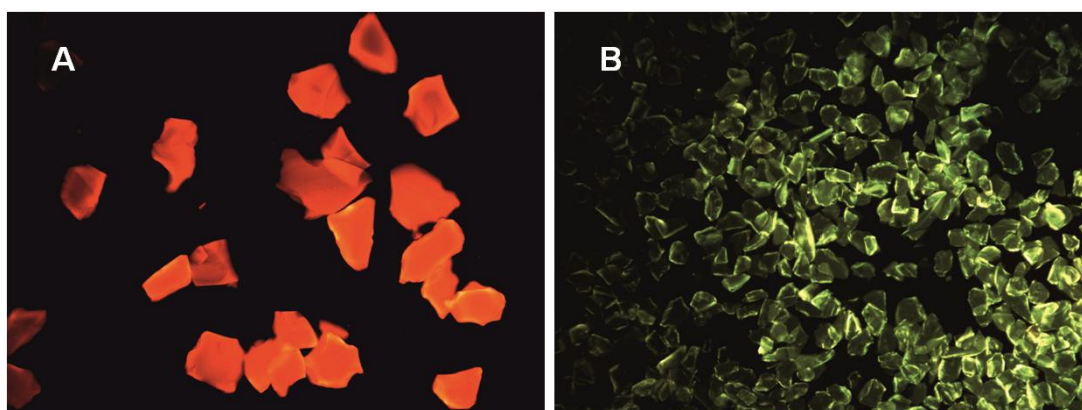


Figure 1: Fluorescence microscopy images of adsorbed GSH QDs (A) and MPA QDs (B) on CPG and CB solid supports, respectively.

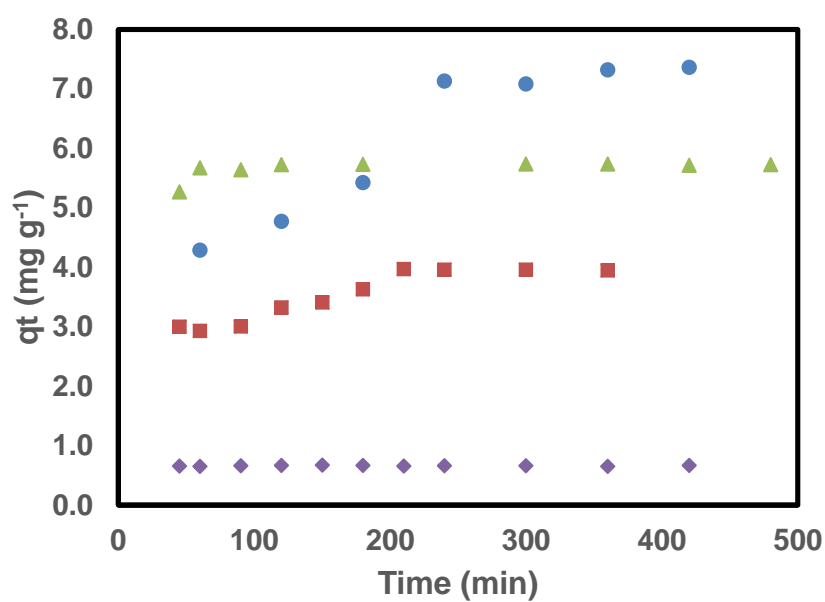


Figure 2: Effect of time on the adsorption efficiency of QDs by solid support. GSH-QD (●), MPA-QD (▲), TGA-QDs (■) and CYS-QDs (◆).