Multimodal Nanosensors Comprising Hydrophilic Silver based Quantum Dots and Gd-DOTA Complexes

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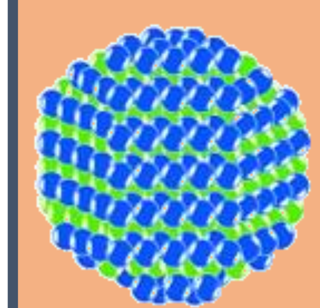
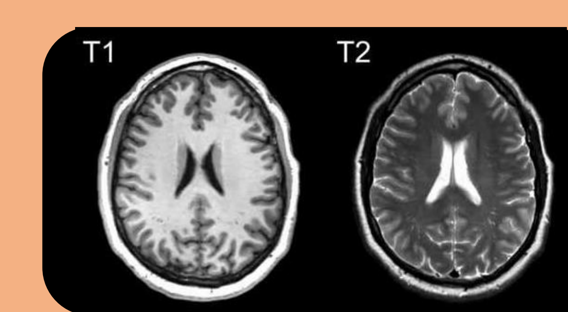
INTRODUCTION

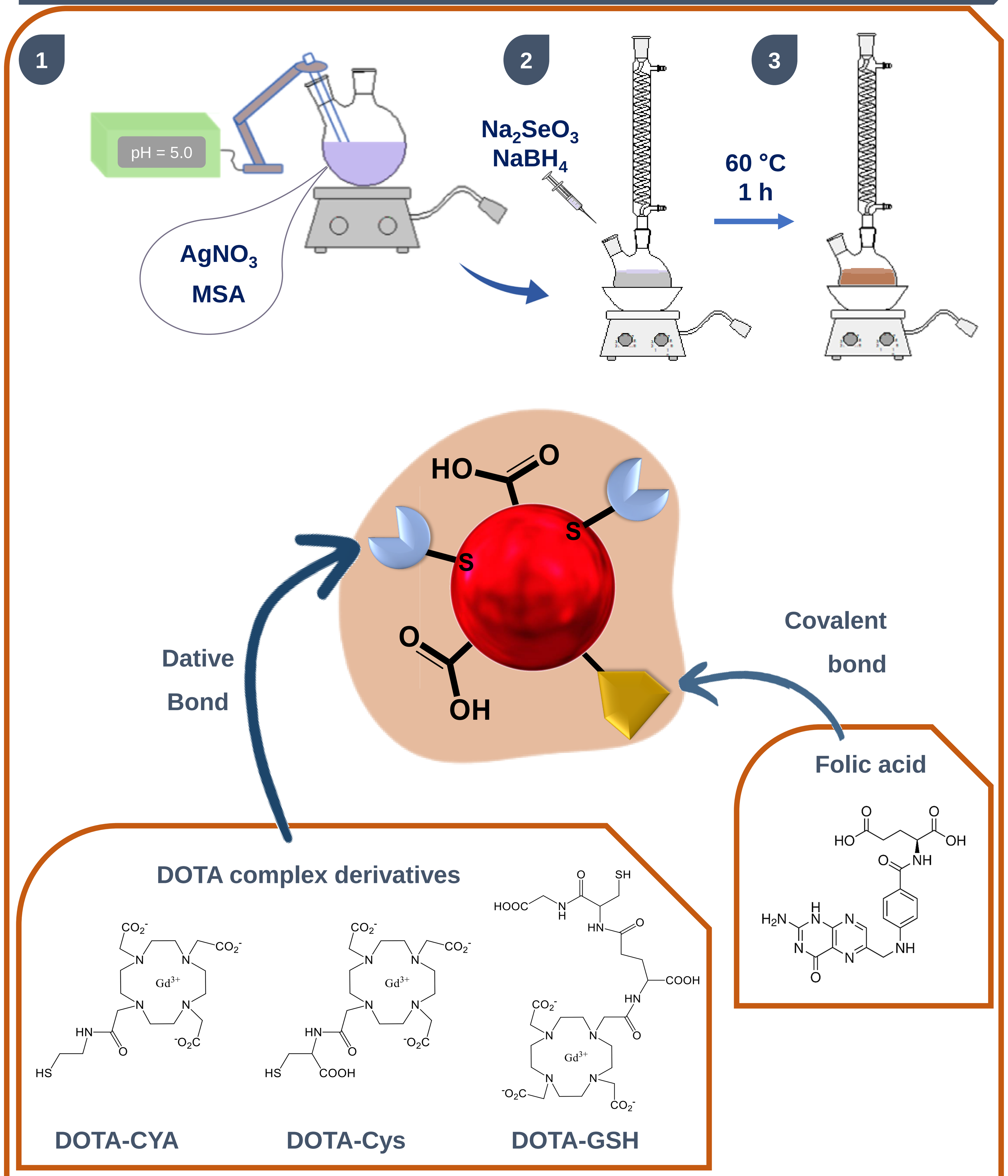


Quantum Dots (QDs) are semiconductor nanocrystals with outstanding optical properties, which make them particularly promising for biomedical applications, including their use as nanoprobes for diagnostic imaging. One of their key advantages is their active surface, which facilitates (bio)conjugation, allowing them to be attached to contrast agents (CAs) and (bio)molecules. Among these (bio)molecules, folic acid (FA) stands out due to its specific targeting capabilities for cancer cells, attributed to the overexpression of folate receptors on the surface of most cancer cells.[2]

Magnetic resonance imaging (MRI) is a non-invasive and powerful diagnostic imaging technique know for its high resolution. Despite its low sensitivity, a better contrast in the image can be achieved using CAs.[1] The combination of QDs and CAs in the same system, provides a nanosensor with the potential to be applied in fluorescence and MRI dual-imaging, offering the potential for simultaneous fluorescence and MRI imaging.[2]

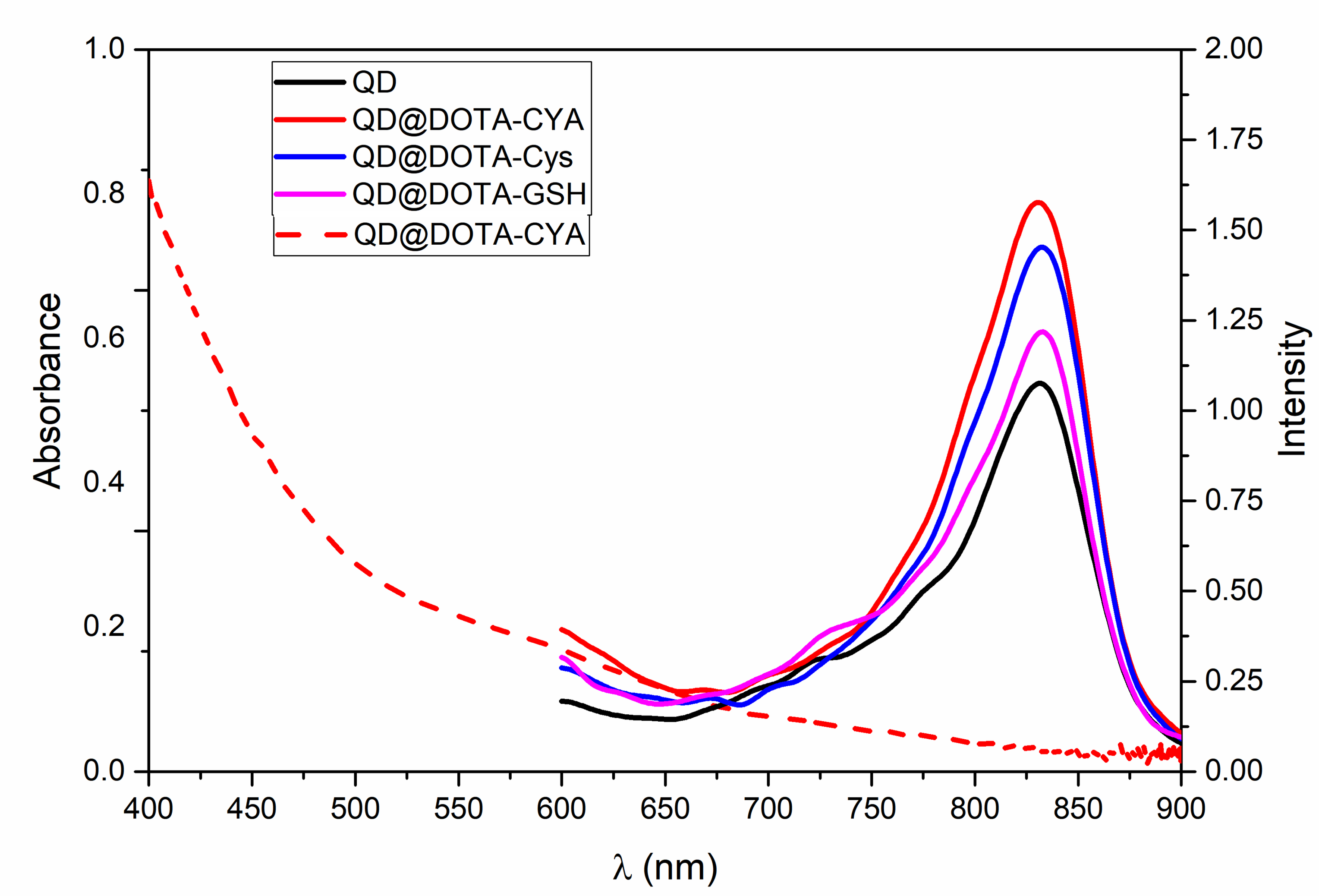


METHODOLOGY



RESULTS

Sample	λ_{emi} (nm)	%variation in emission intensity	FWHM (nm)
Ag_2Se	836	–	65
QD-DOTA-CYA	829	51,3	67
QD-DOTA-Cys	834	39,6	66
QD-DOTA-GSH	832	27,0	61



Sample	20 MHz ; 25 °C		20 MHz ; 37 °C	
	r_1 ($mM^{-1}s^{-1}$)	r_2 ($mM^{-1}s^{-1}$)	r_1 ($mM^{-1}s^{-1}$)	r_2 ($mM^{-1}s^{-1}$)
QD@DOTA-CYA	5,60	7,83	5,61	5,93
QD@DOTA-Cys	5,29	9,17	4,62	7,46
QD@DOTA-GSH	6,48	6,11	5,67	8,13

CONCLUSION

In conclusion, in this study, Ag_2Se QDs were prepared in an aqueous medium, using a one-pot method. These QDs were effectively conjugated with thiolate DOTA complex derivatives and folic acid molecules, resulting in nanosensors with enhanced emission intensity compared to bare QD. Additionally, relaxometric studies demonstrated that the relaxivity *per* Gd^{3+} of these nanosensors is superior to that of the free Gd-DOTA complex in solution. Thus, these results suggest that the developed nanosensors have significant potential as CAs for cancer diagnosis.

ACKNOWLEDGMENTS

UFPE · Universidade de Coimbra · FACEPE · CNPq · CAPES · CESAM · FCT

References:
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[2] Viegas, I. M. A., Gonçalves, I. W. V., Santos, B. S. Fontes, A., Pereira, M. G. C., Pereira, C. F., Pereira, G. A. L. *New Journal of Chemistry*, **2022**, 46, 21864-21874.