Bimodal Nanoprobes Containing Hydrophilic Quantum Dots and Paramagnetic Chelates

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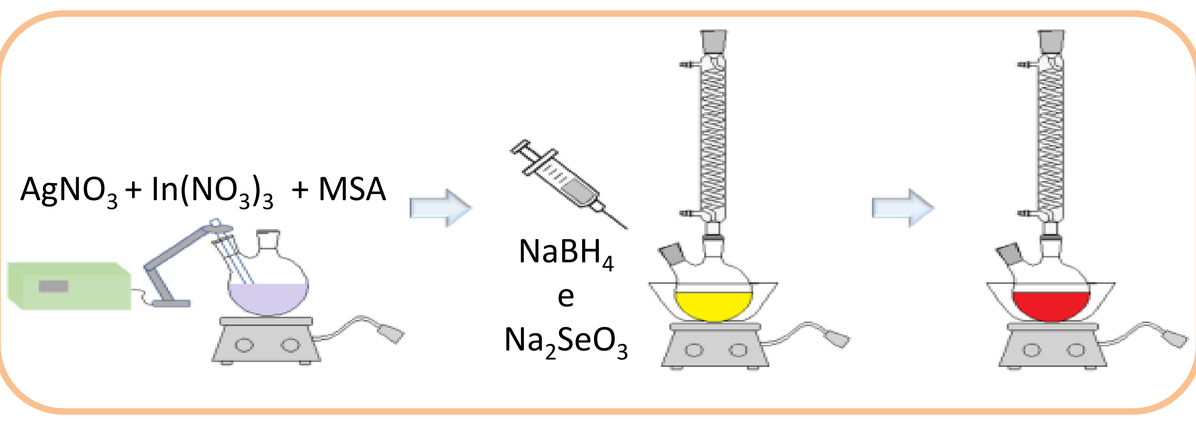
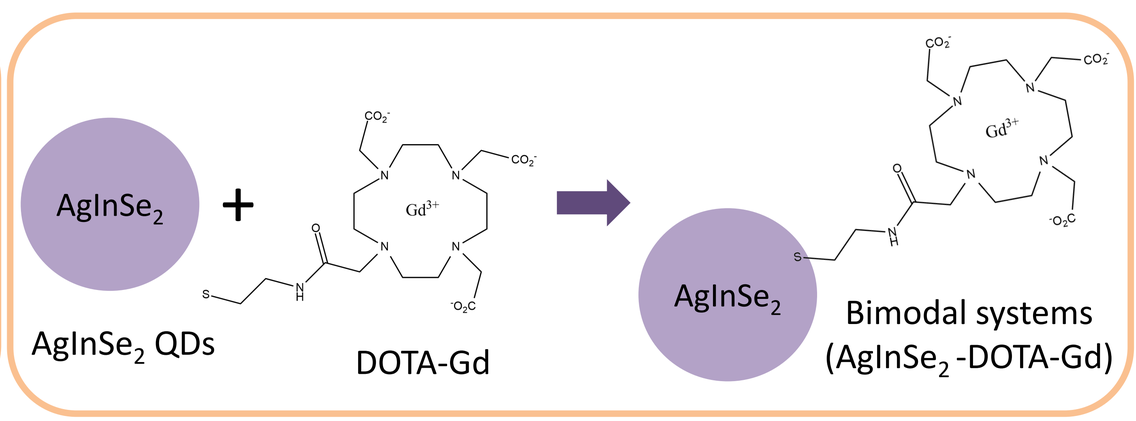
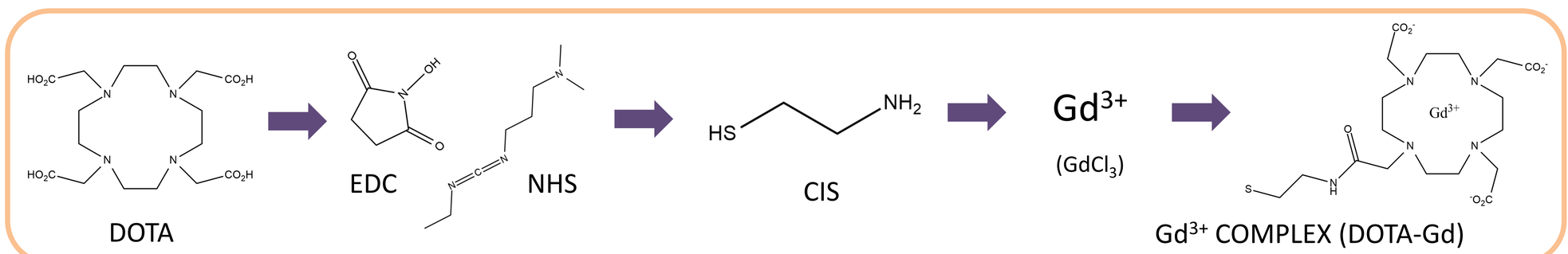
INTRODUCTION

Currently, there is a growing interest in the development of bimodal systems that have a signal for more than one diagnostic imaging technique, such as magnetic resonance imaging (MRI). MRI is able to distinguish pathological from healthy tissues, however, in some cases, a high local concentration of the contrast agents (CAs) is necessary to improve the contrast in the images. Nanoparticulate CAs are able to concentrate several CAs molecules into one nanoparticle, increasing the local concentration of paramagnetic ions.[1,2] Thus, in this work, we intended to associate $AgInSe_2$ quantum dots (QDs) with gadolinium complexes (DOTA-Gd) to develop bimodal systems. The QDs were prepared in water and the synthesis parameters were optimized. The ligand DOTA was conjugated with cysteamine and complexed with Gd^{3+}. The complex was then conjugated to QDs through the metal-thiol bond, obtaining the bimodal systems.

METHODOLOGY

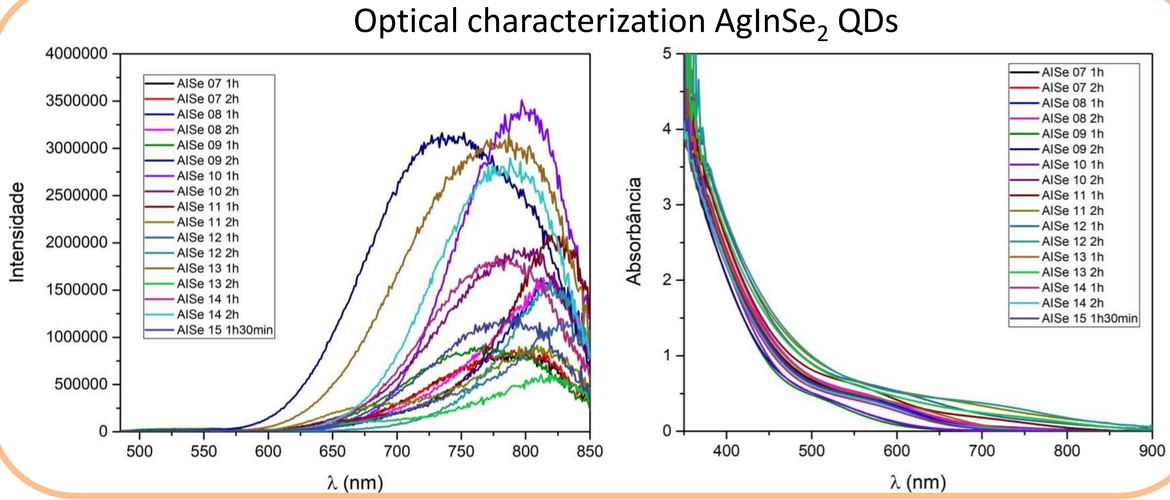






RESULTS

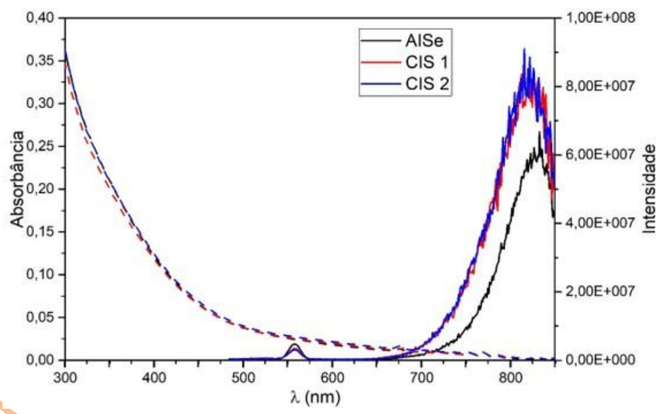
Optical characterization $AgInSe_2$ QDs



Complex characterization

Sample	Complexation yield (%)	r_1 ($mM^{-1}s^{-1}$)
Water	---	***
DOTA-Gd	98,8	3,83
DOTA-CIS	98,7	3,75

Optical and relaxometric characterization of $AgInSe_2$ -DOTA-Gd



Sample	V (μm)	r_1 ($mM^{-1}s^{-1}$)* 25° C	r_1 ($mM^{-1}s^{-1}$)* 37° C
AISe-CIS 1	50	5,20	5,23
AISe-CIS 2	100	6,78	6,30

*20MHz

The QDs remained stable and fluorescent after conjugation, and an increase in emission intensity was observed. The systems were characterized by relaxometry, obtaining longitudinal relaxivities by Gd^{3+} higher than the CAs used clinically.

CONCLUSION

In this work, $AgInSe_2$ QDs were obtained with good optical properties. The thiolated Gd^{3+} complex showed similar relaxivity and stability values to clinically used DOTA. The prepared bimodal systems maintained the optical properties of the QDs, and showed higher relaxivity values than the DOTA-Gd. Therefore, the methodology used proved to be effective, promising and easy to implement. Furthermore, the prepared bimodal systems have the potential to be used as contrast agents for optical and magnetic resonance imaging.

REFERENCES

[1] ALBUQUERQUE, G. M. *et al*. **Topics in Current Chemistry**, v.379, p.12, 2021.
[2] LANDINI, L.; POSITANO, V.; SANTARELLI, M., Eds. **Advanced image processing in magnetic resonance imaging**. Boca Raton: Taylor & Francis grouped. 2005.