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FNA ENCAPSULATION WITHIN SILICA-ZIRCONIA POROUS THIN FILMS FOR FLUORESCENCE REPORTING

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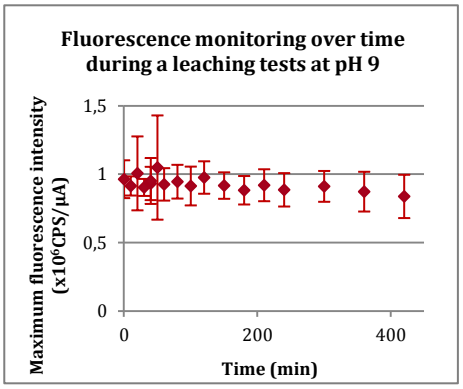

Porous materials, when adequately tailored, offer the possibility to entrap various biomolecules without altering their conformation or function. The sol-gel process, ideally versatile to prepare such biohybrid materials, has been applied to the encapsulation of all kinds of biological species, from proteins to whole cells, usually in order to develop biosensors.

Simultaneously, functional nucleic acids (FNAs) were reported as new promising molecular recognition elements, whether as specific ligands (aptamers) or catalysts (deoxyribo- or ribozymes). Indeed, FNAs may theoretically be selected to match any given target, regardless of its nature (ions, small molecules, proteins, peptides, or even cells).

Performing sol-gel encapsulation of FNAs is a promising way to develop new medical sensors, especially through fluorescence transduction. However, literature examples of such biomaterials are still few, and focus exclusively on silica materials [1][2]. Considering the poor stability of silica at alkaline pH and the fact that most biological conditions require a pH higher than 7, the encapsulation of FNAs in silica-zirconia mixed oxides thin films was investigated. Special attention was paid to the diffusion of small molecules into the immersed resulting materials, as this aspect is essential to obtain such a functional biomaterial.

In order to spare precious biological samples, small volumes of sols containing silica/zirconia precursors and fluorescently-labelled oligonucleotides were spin-coated onto quartz substrates and uniform films with controlled thickness were obtained. Films stability was assessed in alkaline solutions up to pH 11 and resistance to basic conditions was established. Films were further characterized through front face fluorescence spectroscopy by carrying out leaching tests and FNAs assays. FNA encapsulation was successfully performed in the silica-zirconia materials, establishing the possibility to create fluorescence-based sensors with these biomaterials. Diffusion experiments of molecules of various sizes and natures (fluorophores, FNA's target, FNA) in the films were performed to better understand the impact of the porous network on such functional materials.

[1] N. Rupcich, R. Nutiu, Y. Li, and J. D. Brennan, *Anal. Chem.*, 2005, 77, 4300-4307.
[2] C. Carrasquilla, P. S. Lau, Y. Li, and J. D. Brennan, *J. Am. Chem. Soc.*, 2012, 134, 10998-11005.

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