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Functional nucleic acids (FNAs) are promising molecular recognition elements, either as specific ligands (aptamers) or as 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). They are thus widely used for analysis applications, through different sensing technologies.

Porous materials, when adequately tailored, offer the possibility to entrap various biomolecules without altering their conformation or function. The sol-gel process enables the formation of porous glasses or ceramics through polymerization at room temperature of liquid precursors (mainly metal or metalloid alkoxides). Upon fine-tuning, the resulting materials may display interesting properties such as optical transparency, tailored porosity, thermal or mechanical stability. In addition, such materials can be produced in a great variety of shapes (thin films, powders, monoliths, fibers, etc.). The sol-gel process is thus ideally versatile to prepare biohybrid materials, and has been applied to the encapsulation of all kinds of biological species, from proteins to cells, usually in order to develop biosensors.

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.

In order to spare precious biological samples, small volumes of solutions containing silica/zirconia precursors and fluorescently-labelled oligonucleotides were spin-coated onto quartz substrates. Uniform films with optical transparency, adjustable porosity and 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.

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