Synthesis of Fluorescent Nanovesicles Quatsomes for Bioimaging

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Nowaday, fluorescent organic nanoparticles (FONs) have become a very interesting tool for bioimaging. In particular dye-loaded small unilamellar vesicles (SUVs) permit the encapsulation of large quantity of fluorophores in a very small space, drastically improving the brightness many-fold compared to single organic dyes [1]. Their amphiphilic environment considerably stabilizes the poorly water soluble organic dyes in biological media permitting their use for *in vivo* and *in vitro* applications. In addition, considering the multifunctionality properties of nanoparticles, active delivery and site specific targeting could be developped raising real interest in the field of theranostic.

Here we presente new type of FONs based on the use of quatsomes [2], a new type of nanovesicles. Quatsomes are constituted from quaternary ammonium surfactants and sterols which self-assemble forming stable amphiphilic bimolecular building-blocks with the appropriate structural characteristics to form, in aqueous phases, closed bilayers. The outstanding thermodynamic stability of these nanovesicular architectures, the high vesicle to vesicle homogeneity in size, lamellarity and chemical composition, their stability upon dilution, their low toxicity, their good recovery after liophilization and the availability in pharmaceutical grade of their components, make them ideal colloidal nanoparticles for the engineering of a new class fluorescent probes, with optical, targeting and delivery properties easy tunable through self-assembly strategies. Three different strategies were used for the loading of molecular commercial and non-comercial dyes in quatsomes [3]:

i) The decoration of cationic quatsomes with anionic water-soluble dyes,
ii) The partial substitution of cholesterol with a dye-functionalized cholesterol,
iii) The encapsulation of hydrophobic dyes inside the bilayer via a *membrane anchoring* mechanism.

In particular, this last strategy considerably improved the water dispersibility of hydrophobic dyes containing long alkyl chains by their ability to penetrate the membrane bilayer of quatsomes. When prepared using compressed fluids methodology (DELOS-SUSP) [4], these fluorescent vesicles were stable over months and demonstrated high brightness. In some cases, dyes loaded in quatsomes demonstrated better photostability than single dye in solution.

Therefore, quatsomes constitute a interesting platform for the nanostructuration of organic dyes in water, preserving their optical properties while being highly versatile. These finding open a huge range of possibilities in their use for diagnosis and theranostic applications.

References

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