

# Quatsomes: stable and versatile vesicular scaffolds for nanostructuring organic dyes in water

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Fluorescence imaging is a powerful tool for research and diagnostics. The potential of this technique is strongly affected by the optical and physicochemical properties of the fluorescent probe<sup>1</sup>. Organic dyes, whose properties can be tuned via structural modification, are actively investigated in this direction, although their low solubility in aqueous and biological media strongly limits their use for *in vivo* and *in vitro* applications. Fluorescent organic nanoparticles<sup>2</sup> represent a promising route to bring organic dyes in aqueous media, with the possibility to add other functionalities, such as drug-delivery or site specific targeting. Indeed multifunctional fluorescent nanoparticles are attracting a large interest for theranostic applications. Here we present Quatsomes (Qs), a class of small unilamellar vesicles (SUVs), as a versatile and stable scaffold for nanostructuring organic dyes in water, using different dyes with different optical and physicochemical properties.

Qs are formed by the self-assembly of quaternary ammonium surfactants (e.g. CTAB) and sterols (e.g. cholesterol) in water<sup>3, 4</sup>. Qs are good protein delivery nanocarriers and their surface can be easily functionalized with targeting peptides.<sup>4</sup> Several strategies for the preparation of Qs-dyes are presented, including: i) the decoration of the positively charged surface of Qs with anionic water-soluble dyes, ii) the partial substitution of cholesterol with a dye-functionalized cholesterol and iii) the encapsulation of hydrophobic dyes inside the bilayer via a *membrane anchoring* mechanism. By this last strategy, it was possible to disperse in water commercially available as well as newly synthesized hydrophobic dyes with long alkyl chains. When prepared by using compressed fluids (DELOS-SUSP method<sup>5</sup>), the decorated Qs are strongly fluorescent and are stable over months. Moreover, a study on photostability of Qs-dyes showed that in some cases dyes can be more photostable when loaded on Qs membrane than in solution.

Qs constitute therefore a versatile platform for nanostructuring organic dyes in water, preserving their optical properties and providing the possibility of specific targeting and/or drug-delivery, then opening new possibilities in theranostic applications.

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