First experimental study of self-forming synthetic lipids by confocal laser tweezers Raman spectroscopy

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We present the first experimental study of self-forming synthetic lipids, trademarked as QuSomes™, using Raman spectroscopy in the spectral range of 500 to 3100 cm\(^{-1}\). Raman spectra of these new artificial lipids such as 1,2-dimyristoyl-rac-glycerol-3-dodecaethylene glycol (GDM-12) and 1,2-dioleoyl-rac-glycerol-3-dodecaethylene glycol (GDO-12) have been obtained in neat form and in aqueous suspensions with Phosphate Buffered Saline (PBS) by using an inverted confocal laser-tweezers-Raman-microscopy system. This spectrometer works with an 80 mW diode-pumped solid-state laser, operating at a wavelength of 785 nm in the TEM\(_{00}\) mode. The laser is used both for optical trapping and Raman excitation. The two amphiphiles considered in this study, differ in their hydrophobic chain length and contain similar hydrophilic polyethylene glycol (PEG) head groups. Such synthetic PEG coated lipids exist in liquid form at room temperature and spontaneously form liposomes (nano type vesicles) upon hydration. In this work, we have focused on the band assignments for the spectra of single QuSomes™ nano particles in pure form and aqueous media acquired by means of Raman spectroscopy. In particular, we have found that the most prominent peaks in the studied spectral region are dominated by vibrational modes arising from C−C and CH\(_2\) bonds. Furthermore, we have noticed that some of the distinct peaks observed below 1800 cm\(^{-1}\) in pure sample are preserved in aqueous environment. These retained intense bands are located at 1449, 1128, 1079, and 1065 cm\(^{-1}\). This effect might be due to the strong chain-chain interactions, because the chains have to orient themselves and become tightly packed in the vesicles wall rather than adopt random orientations in bulk. This technique has proven to be an excellent tool to establish the fingerprint region revealing the molecular structure and conformation of QuSomes™ particles. The Raman spectroscopic data of these novel lipids and its vesicles formed in suspensions confirm high stability and are therefore considered as potential candidate for varieties of future applications including lipid based novel substances and drug delivery systems.