Hybrid synthetic/biogenic non-lamellar lipid films

Sharareh Rezaei[a], Costanza Montis[a]

[a]University of Florence

sharareh.rezaei@unifi.it

In recent years multiple efforts have been devoted to the development of reliable biomimetic systems, able to reproduce, in simplified and controlled conditions, relevant characteristics of biological membranes [1]. In this respect, synthetic non-lamellar lipid interfaces are particularly attractive, as tools to investigate the behavior of complex biological assemblies [2]. Indeed, despite the ubiquitous nature of non-lamellar membranes in biological systems, most of their specific functions are still unclear [3].
In this contribution we challenge supported lipid bilayers (SLBs) of variable composition with lipid nanoparticles (LNPs) of different structure (hexosomes, cubosomes), as a strategy to build-up new biomimetic surfaces. Quartz Crystal Microbalance experiments highlighted a tunable interaction mechanism between LNPs and SLBs, dependent on the SLBs composition. Structural studies in solution (Small Angle X-ray and Neutron Scattering) and at the solid-liquid interface (Neutron Reflectometry) revealed the successful permanent anchoring of the LNPs to the target lipid membrane, in a charge-dependent manner, with the liquid crystalline structure of the LNPs preserved. Confocal Microscopy experiments revealed that the adhesion of the LNPs to the target SLBs occurs via diverse mechanisms, implying lipid exchange and/or extensive adsorption, eventually leading, in selected conditions, to the formation of patterned surfaces, with discrete LNPs exhibiting a regular arrangement.
These results show that, by tuning the SLBs composition, LNPs-SLB interaction can be modulated, eventually leading to the controlled formation of patterned surfaces decorated with discrete non-lamellar lipid nanoparticles, which could represent a new biomimetic platform for studies on non-lamellar membranes.

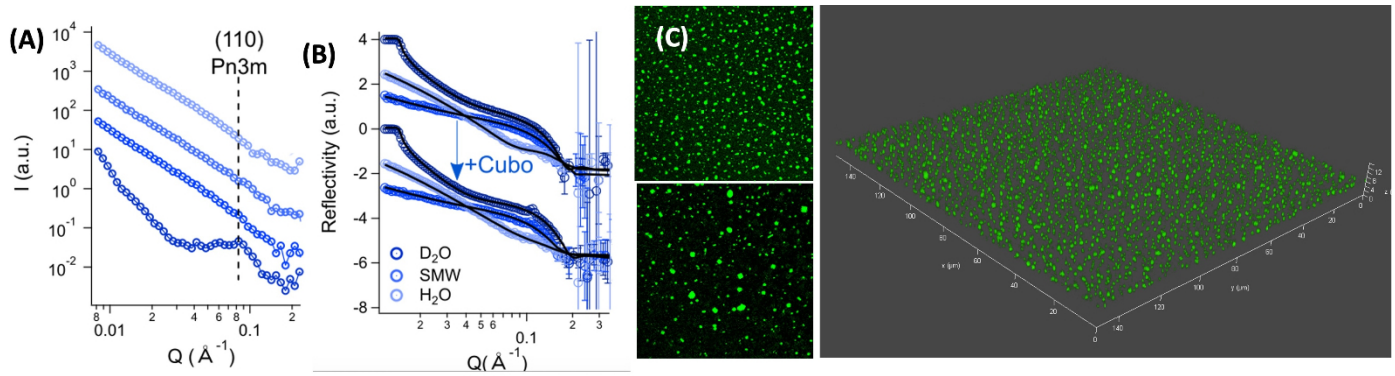

FIGURE 1 (A-B) SAS and (B) NR data on LNPs - lipid vesicles (A) and LNPs SLBs (B) interaction; (C) patterened surfaces visualized via confocal microscopy

References:

[1] Mendozza et al. Soft Matter 2019, 15, 8951
[2] Caselli et al. Phys. Chem. Chem. Phys. 2022, 24, 2762
[3] Mezzenga et al. Adv. Mater. 2019, 31, 1900818

Acknowledgements:

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101169269.