Abstract ID : **56**

Phase transition and lipid flip-flop coupling in model lipid bilayers

Content

Solid-supported lipid bilayers (SLBs) are widely used tools in biological and technological studies, for the investigation of interactions and molecular processes involved in cell function, disease and for sensing applications [1,2]. Moreover, SLBs are one of the prototypes of natural self-assembling systems. One of the most debated phenomena in cell membranes is a structural rearrangement called lipid flip-flop, i.e. the movement of lipid molecules across a membrane.

By performing time- and temperature resolved neutron reflectometry experiments on the high flux time of flight reflectometer D17 we provided a real-time direct characterization of the internal structural changes taking place in symmetric and asymmetric SLBs across their phase transitions. In particular, we demonstrated how this method can be used to obtain direct information on the melting behaviour of the proximal and distal leaflets in SLBs and to quantify therefore their degree of coupling during the main phase transition [1].

By using the same approach, we demonstrated that asymmetric systems prepared in the gel phase are stable for at least 24 hours and that lipid flip-flop resulted to be intrinsically linked to the appearance of fluid domains in the system [2]. Moreover, the growth of these domains during the broad phase transition resulted to be the main key factor for the timing of the flip-flop process. By exploiting different temperature scan rate, we could demonstrate that, in the case of supported bilayers and for the temperature investigated, the lipid flip flop is characterized by an activation energy of 50 kJ/mol and a timescale on the order of few hours providing a land-scape for discussing the origin on the existing discrepancies [3] between flip-flop in bulk systems and at interfaces.

References

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Primary author(s) : Dr. GERELLI, Yuri (Università Politecnica delle Marche)

Co-author(s) : Dr. PORCAR, Lionel (Institut Laue - Langevin)

Presenter(s) : Dr. GERELLI, Yuri (Università Politecnica delle Marche)

Submitted by **GERELLI, Yuri** on **Tuesday 29 March 2022**