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Exploring the Bacterial Envelope and Model Biomembranes with AFM

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Atomic Force Microscopy (AFM) is a powerful tool for visualizing the morphology of cells and membranes in buffer solution and Force Spectroscopy (FS) allows analyzing the localization, interactions and mechanical properties of their individual components.

We have studied the nanomechanical properties of the cell envelope down to the molecular level of *Bordetella Pertussis*, a pathogenic bacteria responsible of whooping cough, a highly infectious disease. A relationship between stiffness and adhesin clusters was established. Antibiotic-effect on individual and grouped bacteria was followed by topographic and nanomechanical properties and the beneficial effect of consortiums to resist different therapeutic strategies was examined.[1]

Regarding model biomembranes, Force Spectroscopy (FS) was used to discriminate different phases that coexist in the ternary lipid mixture (DOPC/ 16:0-SM/Cho) that exhibits phase coexistence, i.e. a liquid-ordered (L_o) phase enriched in sphingomyelin (SM) and cholesterol (Cho) which is segregated from the liquid-disordered (L_d) phase composed mainly of DOPC. This ternary lipid mixture mimics lipid raft-like domains. Supported lipid bilayers (SLBs) were formed on mica and Au Surface Plasmon Resonance(SPR) sensor chips. The presence of different lipid phases was characterized by topographic AFM images and by FS.[2] The nanomechanical properties of SLBs formed on polycrystalline Au were comparable to the ones obtained on a flat mica substrate which corroborates the adequate formation of SLBs on Au chips. This finding opens a great variety of studies concerning interactions of model biomembranes with biomolecules, surfactants and nanomaterials among other systems by SPR.

References

[1] Atomic Force Microscopy in Liquid: Biological Applications. A. M. Baró and R.G. Reifenberger (Eds) Wiley-VCH. Weinheim, Germany (2012)
[2] Daza Millone et al, Colloids and Surfaces B: Biointerfaces, **172**, (2018), p.423

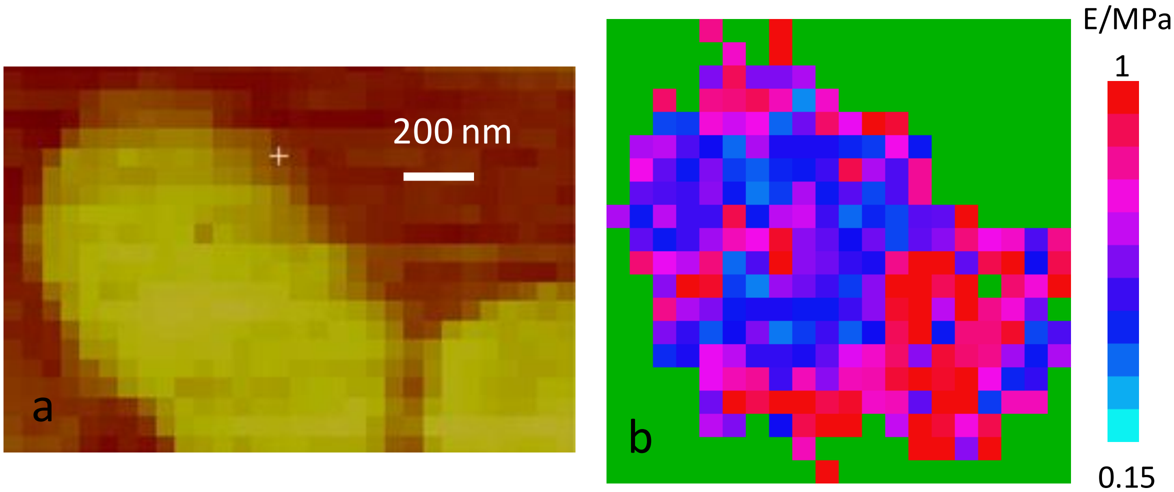

Figure 1: a) Force volume image of *Bordetella Pertussis* b) Elasticity map

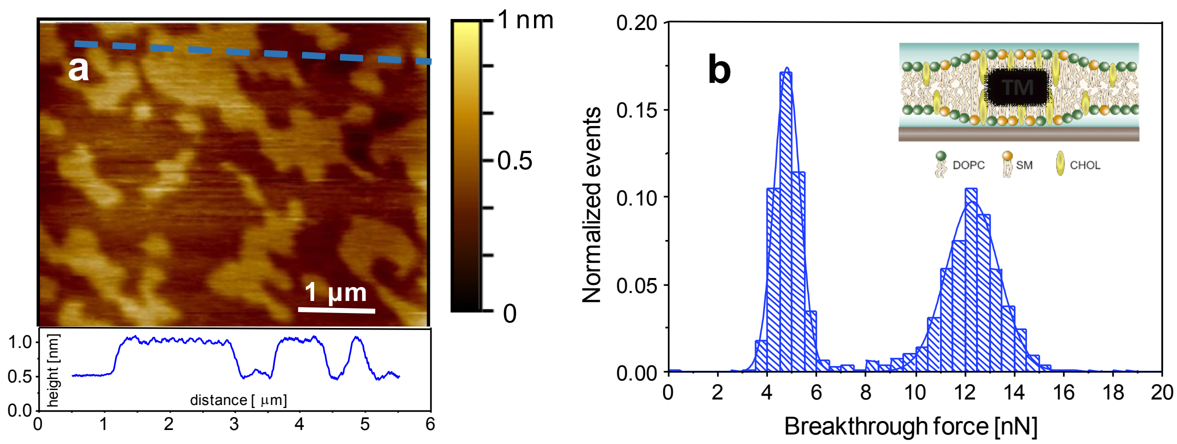

Figure 2: a) Topographic image of model biomembranes formed by ternary lipid mixtures (TM)(DOPC/SM16:0/Cho 2:1:1) b) Force spectroscopy of the TM shown in a) showing the typical breakthrough forces of liquid-disordered and liquid-ordered phases

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