



Contribution ID: 89

Type: Poster

AFM automation allows high throughput nanomechanical characterization of vesicles

Extracellular Vesicles (EVs) are unique, heterogeneous lipid bilayer-based nanoparticles secreted by cells. Their subpopulations differ in size, charge, biogenesis and vesicle lamellarity. As potential class of cell-free diagnostic and therapeutic vehicles, their physical chemical characterization, in particular their mechanical properties, are an issue of recent investigations [1,2]. As nanometric objects, AFM presents itself as a striking technique for their characterization, which has previously been done using imaging modes[3] or force spectroscopy modes – from using simple parameters such as linear stiffness to the more standardized Young's modulus to evaluate elasticity, thin-shell theory or an ad hoc model elaborated by Roos & Wuite's groups based on a modification of Calham-Helfrich theory[2]. In the latter, the authors elegantly describe a method to estimate stiffness, osmotic pressure and bending modulus of the vesicle [4].

Here, we adapt an automation procedure developed in-house in a sequential multi-sample fashion operating in fluids applied to prokaryotic cells [5] by which we can map automatically each vesicle, raising the throughput of vesicle measurements to hundreds per preparation, and analyze by comparing the different existing mechanical models. As a proof of concept, we are using synthetic vesicles.

References

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- [2] M. LeClaire et al., Nano Select 2021, 2, 1.
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Session

Molecular interactions at the membrane surface

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Session Classification: Clip Session