

Design and mechanical characterization of a plant primary cell wall analogue : cellulose/xyloglucan multilayered capsules

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Plant cell shape and growth are determined by the expansion pattern of the cell wall, a matrix of mixed polysaccharide polymers and proteins. Its structure can be roughly described as a network of cellulose microfibrils tethered by hemicellulose, embedded in a highly hydrated pectin matrix. However, probing these components respective contributions in the overall mechanical behaviour of the wall is still a current challenge in plant cell biophysics.

In this context, this work aims at designing plant cell wall mimicking capsules with controlled architecture, in order to study their mechanical properties. For this purpose, we took advantage of the strong interaction between cellulose nanocrystals (CNC) and xyloglucan (XG) (the most common type of hemicellulose), that has already been successfully exploited to build thin CNC/XG films with the layer by layer method [1]. This non-electrostatic assembly was transposed onto spherical templates : giant unilamellar vesicles (GUVs) with dimensions comprised between 5 and 50 μm . Multilayered CNC/XG capsules have thus been built up to ten bilayers, sequential deposition of the components being followed by confocal microscopy (Fig.1)

Indentation experiments were then performed on these cell wall mimicking objects, using an atomic force microscope (AFM). Young's modulus of the capsules could be extracted from the force-depth curves and found to be in the 10-20 MPa range. These data are in the same order of magnitude as values obtained on onion epidermal peels with AFM indentation [2]. This suggests that artificial CNC/XG microcapsules could be a promising system to get relevant insights into plant cell wall biomechanics.

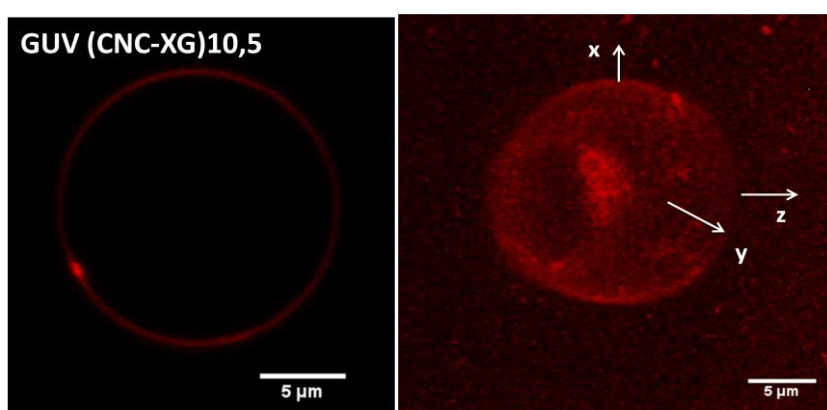


Figure 1 Confocal microscopy image of a 10 bilayers CNC/XG microcapsule (the last layer of CNC being tagged with a fluorophore), with its 3D reconstruction.

[1] B. Jean, L. Heux, F. Dubreuil, G. Chambat and F. Cousin, *Langmuir*, 2009, **25**(7), 3920.

[2] L. Beauzamy, J.Derr and A. Boudaoud, *The Plant Journal*, 2011, **67**, 1116.