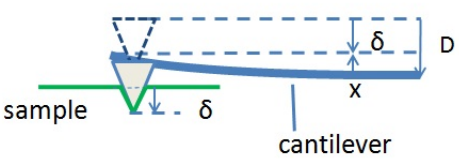
Quantitative measurement of the compressive elastic modulus of plant cell walls in aqueous environment using an AFM-based nano-indentation method

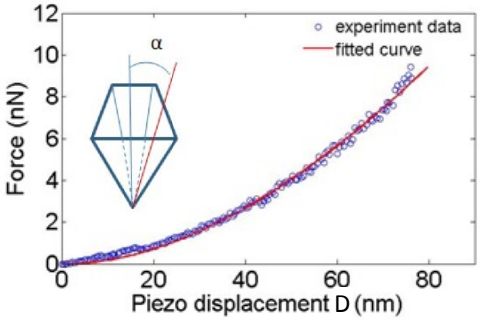
Scientific Achievement

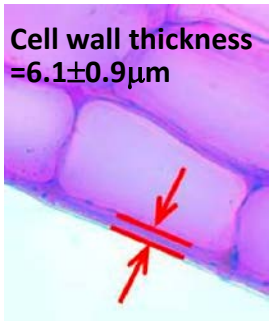
Experimental results for onion epidermis showed that the cellulose microfibril packing is only a minor determinant for the compressive elastic modulus of fully-hydrated cell walls; in contrast, modulation of the pectin network greatly impacted the modulus.

$$F = \frac{E}{1-\nu^2}\frac{tan\alpha}{\sqrt{2}}\left(D - \frac{F}{k}\right)^2$$



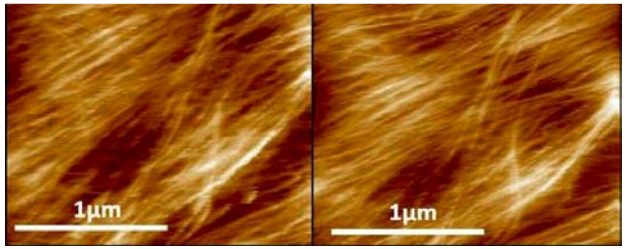
Hertzian indentation model for AfM F-D measurement





Pristine epidermis of onion 5th scale → 23 ± 9 MPa

After partial removal of pectin with EDTA → 16 ± 5 MPa



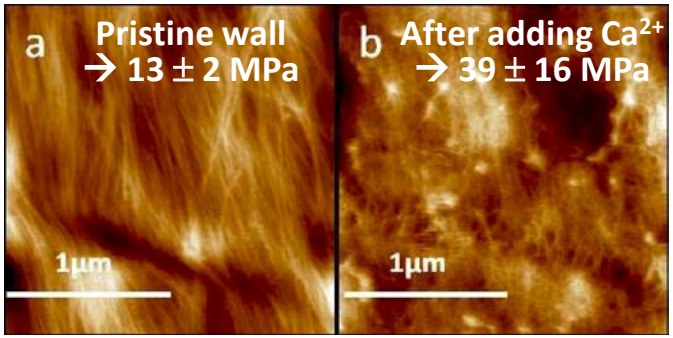
Xi X, Kim SH, Tittmann B. Atomic force microscopy based nanoindentation study of onion abaxial epidermis walls in aqueous environment. *Journal of Applied Physics - Biophysics* **117**, 024703 (2015).

Significance and Impact

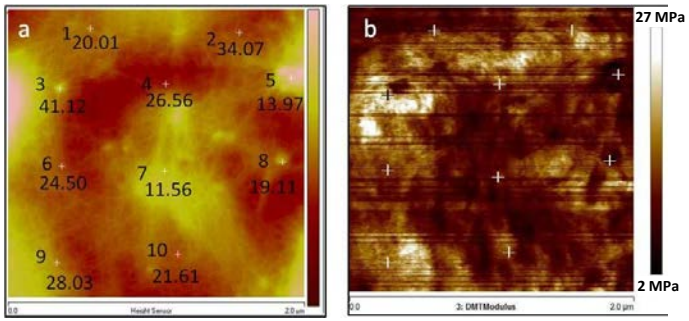
The results show that pectins are major determinants of the compressive mechanics of primary cell walls. This method can be used to study how packing of cellulose microfibrils and matrix polymers affects the mechanics of fully-hydrated primary plant cell walls.

Research Details:

– *Cross-linking of pectin network*



– *Comparison with built-in DMT modulus image of peak-force tapping AFM*



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