High-Field 2D Solid-State NMR Reveals Cellulose Structural Polymorphism in Plant Primary Cell Walls

Significance and Impact

- Cellulose is the most abundant biopolymer on earth, with plant cell walls as its largest source. The structure of plant primary cell wall cellulose evades high-resolution characterization because of its extensive interactions with matrix polymers, which results in low crystallinity. With high-field 2D SSNMR and DFT calculation, the structural polymorphism and the spatial distribution of plant primary-wall cellulose were unveiled.

Scientific Results

- Plant primary-wall cellulose is highly polymorphic.
- Five types (a-e) of interior cellulose and two types of surface cellulose (f and g) mix in the same microfibril.
- Plant primary-wall cellulose has different structure from celluloses of bacterial, algal, and animal origins.
- Cellulose-d interacts with hemicellulose, and is targeted by expansin during wall loosening.

Research Details

- Five primary cell wall samples from Arabidopsis, Maize and Brachypodium were measured using SSNMR.