Integrated Methods for Imaging of Cellulose Composites

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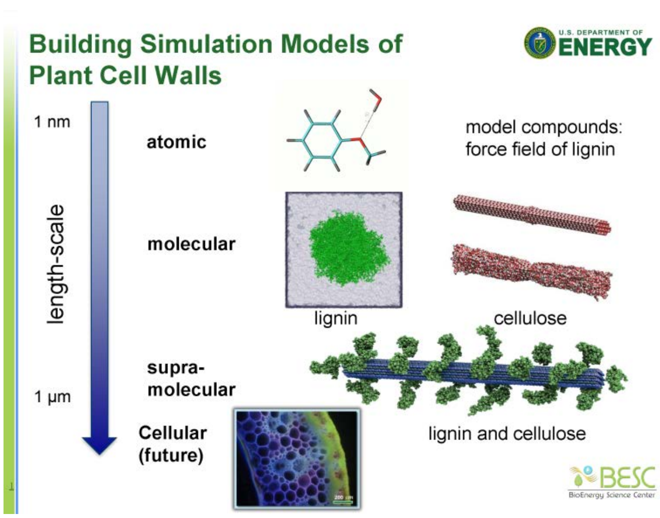
Cellulose is an abundant and widely used biological polymer, most notably as a major component of lignocellulosic biomass produced by plants. The hierarchical assembly of individual glucan chains into a unique crystalline fibrous structure and its combination with other polymers to form both natural and synthetic composites is challenging to elucidate and visualize. Examination of cellulose composite structure at atomic, molecular, and cellular levels is complicated by chemical similarity of the component polymers. To distinguish component polymer interactions, we are using assembly of model composites that strive to emulate chemical and physical properties of lignocellulosic materials. We have developed methods for deuteration of bacterial cellulose and plant lignocelluloses to assist in elucidation of the molecular structure of cellulose and its composites. By isotopic labeling of both natural and synthetic composites with deuterium, individual components can be examined in the composite with FTIR, $^{1}H^{2}H$-NMR, and small angle neutron scattering. High-resolution microscopy can provide the surface and spatial dimensions to relate the data from these bulk methods. Combination of the resolution of atomic force microscopy with chemical force and other techniques can potentially provide nanoscale localization of chemical composition required to understand the properties of these complex materials. Utilizing these data to produce integrated images of composite hierarchical materials requires concomitant development of computer algorithms to analyze data sets. Combination of information from these complementary techniques will enable development of structural models by computational simulation.



References:

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