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Keynote 3, Paavo Penttilä - X-ray and neutron scattering for structural analysis of lignocellulosics

Wednesday 1 June 2022 15:20 (40 minutes)

X-ray and neutron scattering provide powerful tools for the characterization of plant cell wall nanostructures. They require minimal sample preparation and offer possibilities for experiments at various external conditions, such as under varying temperature or humidity. Statistically significant, averaged information of the sample structure over multiple levels of structural hierarchy can be obtained in a single measurement. Scattering methods have therefore yielded significant new information on the structure of lignocellulosic materials in their native, hydrated state and for instance as a function of moisture changes.

Wide-angle X-ray scattering (WAXS) is sensitive to the crystalline portion of cellulose microfibrils, whereas small-angle X-ray and neutron scattering (SAXS, SANS) detect structures of larger length scales. Especially in the case of wood, SAXS and SANS can be used to characterize the lateral size and moisture-sensitive bundling of the microfibrils in the secondary cell walls. The swelling of the microfibril bundles with moisture is associated with changes in the cellulose crystallites, as observed with WAXS.

This presentation introduces scattering-based results on moisture in wood and the interactions of water with microfibril bundles. It includes newly developed tools for the data analysis and complementary results with modelling. It will also cover examples of small-angle scattering analysis of biomimetic composites formed of bacterial cellulose and wood hemicelluloses. These findings highlight the capabilities of scattering methods in the structural characterization of lignocellulosics.

Presenter: PENTTILÄ, Paavo (Aalto University, Finland)