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Learning about wood nanostructure and moisture interactions with SANS

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Wood is an abundant hierarchical biomaterial with a wide variety of current and potential uses. The technological applications of wood range from sustainable building materials to advanced functional nanomaterials made of its smallest building blocks. The wood cell walls consists of well-oriented, elongated structural units from the molecular level to the macroscale, with water being present at all levels. Scattering methods have proven highly useful for non-destructive characterization of the composite-like structure of wood cell walls and their moisture interactions. In particular, results obtained with small-angle neutron scattering (SANS) have made a significant contribution to our understanding of the cell wall structure at the level of cellulose microfibrils (diameter 2-3 nm) and microfibril bundles (diameter 10-20 nm). SANS allows us to observe the moisture-induced swelling of the microfibril bundles, which can be analysed using the WoodSAS model [1]. It can also be used to measure the diameter of microfibril bundles in unprocessed, wet wood samples [2]. Moreover, we have utilized SANS for *in situ* experiments investigating the drying behavior of wood [3] and the exchange of liquid water within the fibrillar structures [4]. This presentation provides an overview of our recent works using SANS to learn about the nanostructure and moisture interactions of wood cell walls.

References:

- [1] Penttilä, P.A., Rautkari, L., Österberg, M., Schweins, R. (2019) *J. Appl. Crystallogr.*, <https://doi.org/10.1107/S1600576719002012>
- [2] Penttilä, P.A., Altgen, M., Awais, M., Österberg, M., Rautkari, L., Schweins, R. (2020) *Sci. Rep.*, <https://doi.org/10.1038/s41598-020-77755-y>
- [3] Zitting, A., Paajanen, A., Rautkari, L., Penttilä, P.A. (2021) *Cellulose*, <https://doi.org/10.1007/s10570-021-04204-y>
- [4] Penttilä, P.A., Zitting, A., Lourençon, T., Altgen, M., Schweins, R., Rautkari, L. (2021) *Cellulose*, <https://doi.org/10.1007/s10570-021-04253-3>

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