The colloidal structure of a regenerated cellulose fiber

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Cellulose is our most abundant biopolymer, and hence an important renewable raw material for many materials. Her, we present a small and wide angle X-ray scattering (SAXS/WAXS) study of regenerated cellulose textile fibers, air-gap spun from an ionic liquid solution.[1] Figure 1 shows SAXS and WAXS patterns from two fibers produced with two different draw ratios, DR=2 and 15, respectively. Drawing the fibers result in an increased degree of orientation of the crystalline domains (Figure 1c and d). By analyzing the azimuthal angular dependence of the WAXS pattern, both the crystal degree of orientation and the degree of orientation of amorphous cellulose chains can be obtained, as well as their relative contributions to the total scattering. Thus, offering an accurate determination of the degree of crystallinity. The anisotropic cross-like 2D SAXS pattern, having scattering predominantly perpendicular and parallel to the fiber axis, suggests an internal colloidal structure with oriented crystalline lamellae of ca. 10 nm thickness, embedded within a continuous matrix of amorphous cellulose. The lamellae are oriented with their normal parallel with the fiber axis.

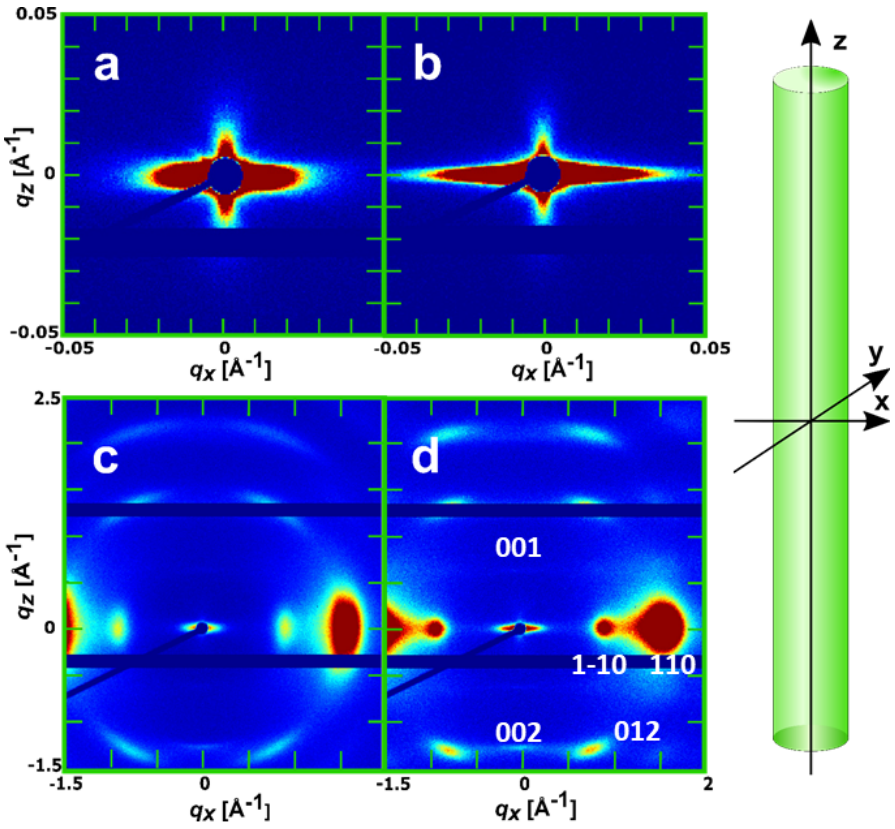

Figure 1. 2D SAXS and WAXS patterns obtained for two different draw ratios. a) SAXS for DR=2. b) SAXS for DR=15. c) WAXS for DR=2. d) WAXS for DR=15 together with an assignment, Miller indices (h,k,l), of some of the reflections. To the right is shown an illustration of the fiber orientation together with the laboratory frame. Here, z is the meridional direction and the equatorial scattering is recorded in the x-direction.

[1] Gubitosi, M., Asaadi, S., Sixta, H., Olsson, U. (2021). *Cellulose.* **70**, 3554.