doi:10.1017/S1431927622005943
Microsc. Microanal. 28 (Suppl 1), 2022

The Crystalline Structure and Fibers of the Red Delicious Cultivar Apple Cellulose by TEM and AFM

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The apple cell wall contains different polymers, giving support and directly affecting fruit firmness. Each cultivar apple has a different structure in its biopolymers, such as shape, content, and organization. That includes nanomechanical and physicochemical properties of the mesocarp of different apples [1]. Studies have even been by spectroscopy, microscopy, nanoindentation, and assays physicochemical for determining the structure tissues apple with its structure cellular. But so far, the crystalline structure of the Red delicious cultivar apple has not yet been characterized at the molecular level. This can demonstrate possible differences at the molecular level with other celluloses of different origin and for which it is essential in the mechanical properties of the fruit as a whole.

The goal is then to explain how the apple cellulose is organized by transmission electron microscopy and atomic force microscopy. Thus the research focuses on finding the crystalline structure and fibers of the Red delicious cultivar apple. Samples are prepared from a cellulose solution at 1% p/v and dissolved in distilled water. It has been mixed in a sonicator (VCX130, SONICS Vibra cell™, Newton CT, USA) with (50% amplitude, 20 kHz, 130 W with a 120 V). An aliquot of 5 µl is then extracted with a micropipette and placed on a copper carbon grid. The electron dose has been restricted to around 35 e− / $Å^2$s by using a monochromator attached to the TEAM 0.5 microscope [2]. Figure 1 shows a typical phase image of the cellulose in the Red Delicious Cultivar. The images are obtained at a voltage of 80 kV. About 40 images have been taken with the focus condition ranging between -20 and 20 nm to perform the output wave reconstruction using the MacTempass software package. For AFM images are taken from a cellulose solution at 1%, mixed with a sonicator, and 0.1 ml is placed on a glass slide and dried out in a desiccator overnight. Six images of each scan and apple cultivar at 2 x 2 μm^2 have been captured in ScanAsyst mode in atmospheric conditions. Figure 1 shows different crystallites with nanometric sizes and with different orientations. The crystallites have a size close to 4 nm, they all give rise to a diffraction pattern typical of the cellulose of the Red Delicious apple. The images of AFM (Figure 2) show fibers of the apple cellulose with diameters around 0.16 to 1.13 nm. These fiber diameter cellulose values are similar to those reported in [1]. As part of future work, the nanomechanical properties of cellulose are under investigation in order to complete the study. This research can help to apply bionanomaterials from apple waste in different industries [3].

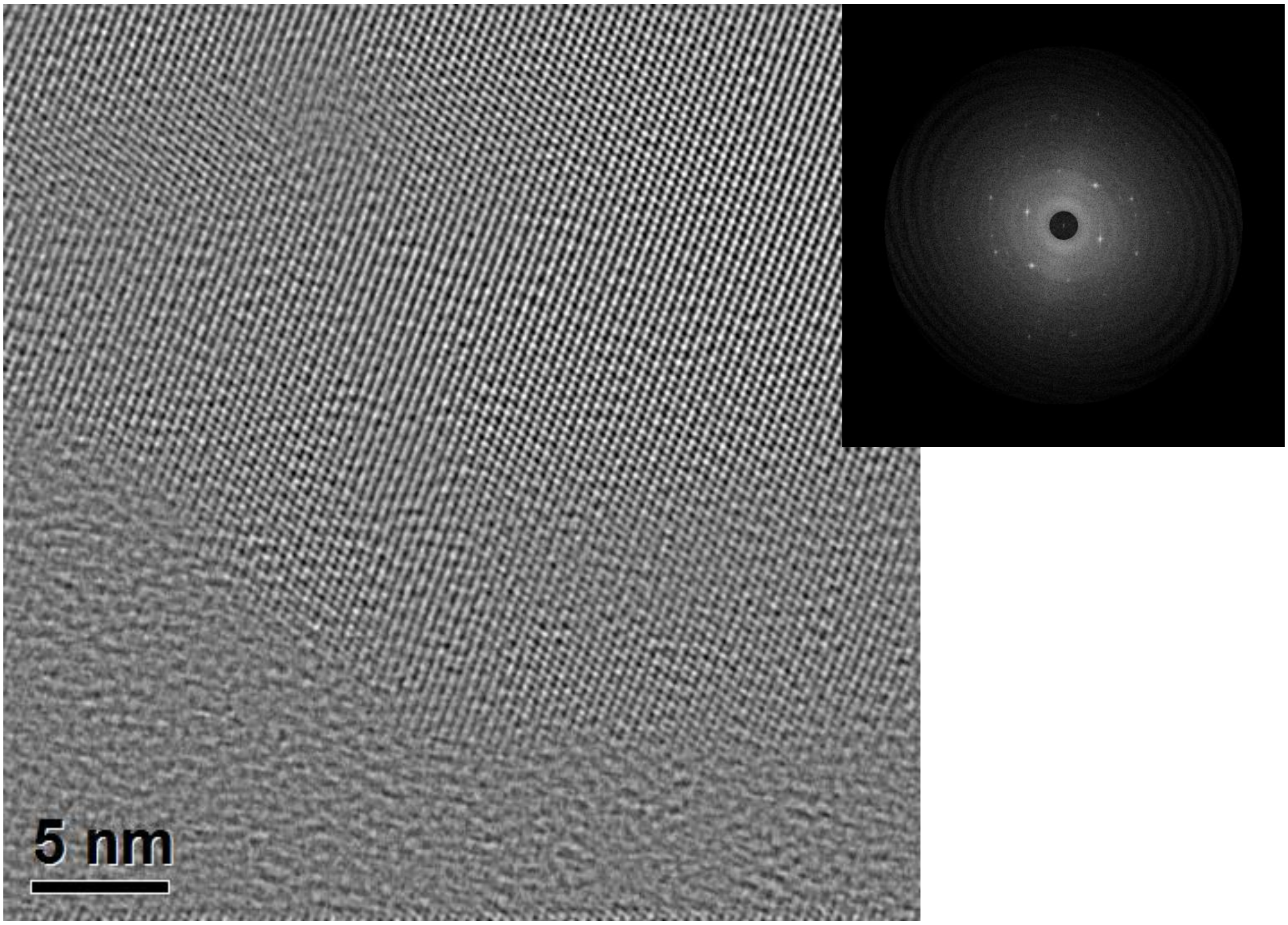

Figure 1. Phase image for the cellulose of Red Delicious apple cultivar and diffraction pattern

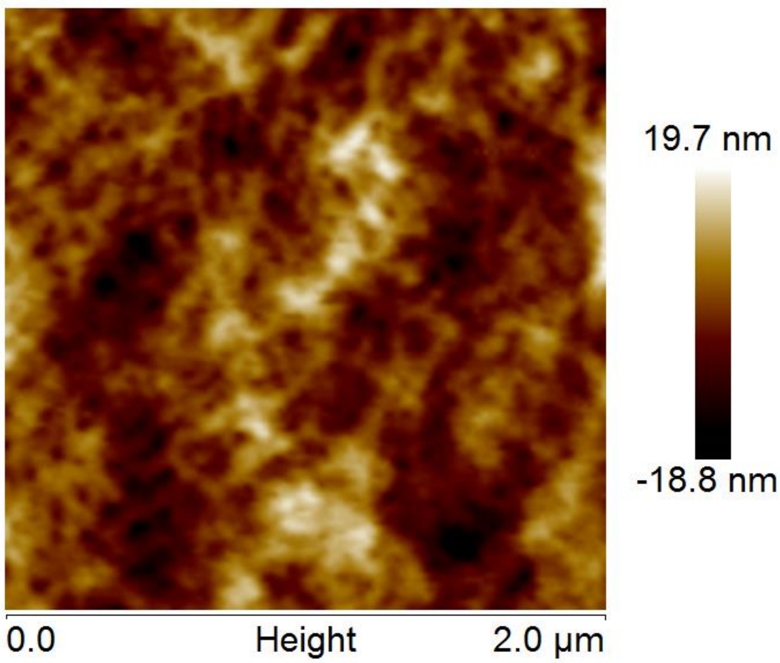

Figure 2. Atomic force microscopy (AFM) height images of isolated cellulose fibers scanned at 2 × 2 µm from Red Delicious apple cultivar

References:

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[3] Work at the Molecular Foundry was supported by the Office of Science, Office of Basic Energy Sciences, of the U.S. Department of Energy under Contract No. DEAC02-05CH11231.