Alternative low-cost extraction of cellulose nanofibers

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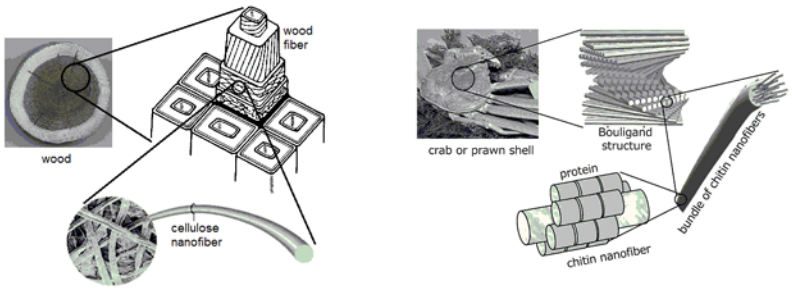
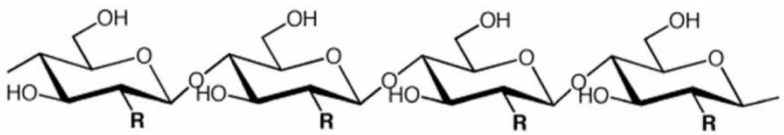


Fig. 1 Typical sources of cellulose (plant fibers) and chitin (crustacean shell) nanofibers



Cellulose: R = OH
Chitin: R = $NHCOCH_3$

Fig. 2 Structural formula of cellulose or chitin. The only difference is the functional group R

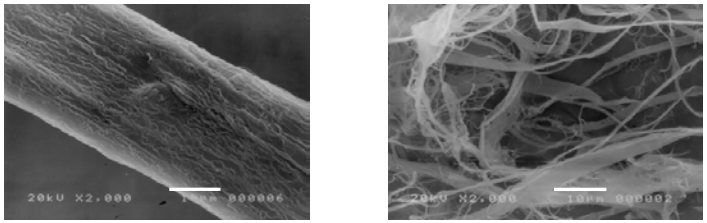


Fig. 3 SEM images of a single pulp fiber (left) and extracted nanofibers (right)

Content:

Cellulose is the most abundant biopolymer on earth, from sustainable resources, biodegradable, and photosynthesized by fixing CO_2 from the atmosphere. Cellulose is mostly found in the cell wall of plant fibers in the form of nanofibers. These tiny elements have mechanical properties similar to aramid fibers, with the potential to reinforce plastics. The extraction, however, requires specialized equipment, has high energy consumption but low yield, and therefore is costly. We are developing alternative methods using affordable and low energy input devices like kitchen blenders and ultrasonicators. Since the mechanical process of nanofibrillation is based on the application of impact and shear forces to break and fibrillate the cell wall of plant fibers, any mechanism to properly apply such forces has the potential to extract cellulose nanofibers at a lower cost.

Chitin is another abundant biopolymer present as nanofibers in the exoskeleton of crustaceans, and can be extracted by the same methods as cellulose nanofibers. Chitin nanofibers can also be used as reinforcement.

Keywords : cellulose, chitin, nanofiber, blender, ultrasonication

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