



## Preparation and characterization of cellulose whiskers from palm, linter, bamboo and coconut fiber

A. K. M. Norões<sup>(1)\*</sup>, D. M. Nascimento<sup>(1)</sup>, M. C. G. Mota<sup>(2)</sup>, N. F. Souza<sup>(2)</sup>, M. M. Souza Filho<sup>(3)</sup>, J. P. Saraiva<sup>(4)</sup>, M. F. Rosa<sup>(3)\*</sup>

(1) Universidade Federal do Ceará

(2) Instituto Federal de Educação, Ciência e Tecnologia do Ceará

(3) Embrapa Agroindústria Tropical, e-mail: [morsy@cnpat.embrapa.br](mailto:morsy@cnpat.embrapa.br)

(4) Embrapa Algodão

\* Corresponding author.

**Abstract** – Cellulose nanowhiskers were prepared by acid hydrolysis from palm, linter, bamboo and coconut fiber. The effects of preparation conditions on the thermal and morphological behaviors of nanowhiskers were investigated.

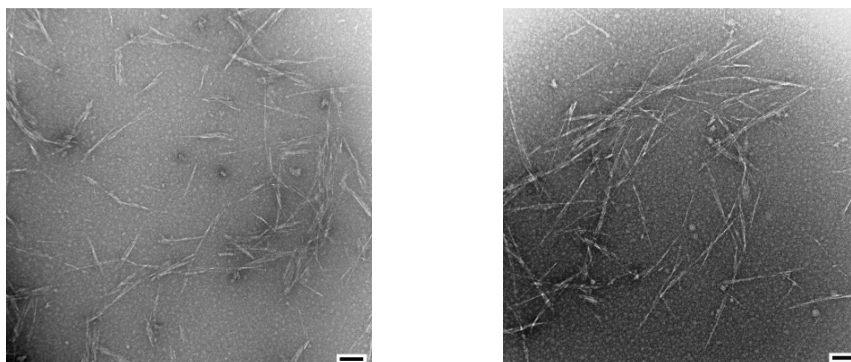
The recent interest in using nanometric particles as reinforcement materials in polymeric matrixes has been increasing. Good examples of these types of particles are cellulose whiskers, nanometer-sized single crystals of cellulose, obtained from renewable sources. Different approaches have been applied to prepare cellulose nanowhiskers. All of them leading to different types of nanostructures, depending on the cellulose raw material and its pre-treatment, and the disintegration process itself.

During the first four years of Embrapa's Nanotechnology Network (Agronano), cellulose nanowhiskers have been successfully prepared from crops and agricultural by-products, stimulating the use of novel renewable sources. The goal of this work was to utilize palm, linter, bamboo and coconut fiber to produce nanostructures that will improve the end-use performance of nanocomposites.

Initially, fibers were subjected to pre-treatments to remove impurities and cementing components around the fiber-bundles. Cellulose whiskers were prepared by sulfuric acid hydrolysis [2] and characterized by thermal analysis (TGA) and transmission electron microscopy (TEM).

The pre-treatment resulted in opening of the fiber bundles, confirming that partial removal of cementing components and defibrillations are important steps towards more efficient pre-treatment and subsequent steps of nanowhiskers hydrolysis. As expected, the aspect ratio [(L/D), particle length (L), width (D)] depended on the source and whiskers preparation conditions. It was possible to obtain ultrathin cellulose nanowhiskers with diameters as low as 5 nm and aspect ratio of up to 60 (Figure 1). Both pre-treatments and preparation conditions affected the degree of crystallinity of cellulose nanowhiskers.

Cellulose nanowhiskers were successfully prepared from palm, linter, bamboo and coconut fiber by acid hydrolysis, stimulating the use of these renewable sources. A future goal is to use these cellulose whiskers as reinforcing elements in composites with biodegradable polymers and evaluate the impact of the processes involved.



**Figure 1:** Transmission electron micrographs of cellulose whiskers from coconut fibers. Scale bars: 100 nm.

### References

[1] M. A. S. A. Samir, F. Alloin, F. and A. Dufresne. *Biomacromolecules* (2005), 6(2), 612–626.

[2] M.F. Rosa, E.S. Medeiros, J.A. Malmonge, K.S. Gregorski, D.F. Wood, L.H.C. Mattoso, G. Glenn, W.J. Orts, and S.H. Imam. *Carbohydr. Pol.* (2010), *in press*.