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Nanocrystalline cellulose from different sources as bio-filler for sustainable rubber composites

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In the last few decades nanocellulosic materials have received increasing interest due to their great strength, high surface area and good renewability. The integration of nanocellulose into polymer matrices has the potential to enhance the performance attributes of the material and increase its sustainability. [1-2] Furthermore, the surface of cellulose can undergo various chemical modifications to enhance the interaction between the filler and the matrix. [2]
The final aim of this project is to produce polymer-based composite materials containing chemically modified nanostructured cellulose, which could enhance the mechanical and barrier proprieties of the polymeric matrix. In this perspective, different cellulosic materials (i.e., hemp pulp, microcrystalline cellulose and microfibrillated cellulose) were treated under different hydrolysis conditions in order to obtain cellulose crystals with nanoscale dimensions (CNC), as shown in Figure 1. The starting materials and the extraction products were chemically characterized via Infrared Spectroscopy (FT-IR) and X-ray diffraction analysis (XRD), while the morphology of the samples was investigated via Transmission Electron Microscopy (TEM). The extracted material was then oxidized through a TEMPO-mediated reaction in order to introduce carboxylic groups on the nanocrystals surface, which can serve as a basis for subsequent functionalization or crosslinking reactions.

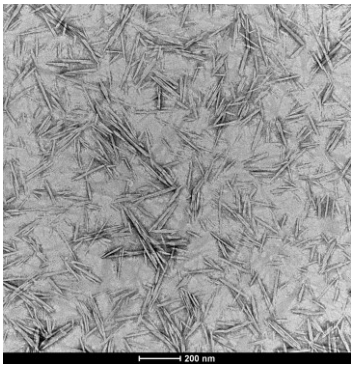

Figure 1: Hemp-derived cellulose nanocrystals (CNC)

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[2] Shojaeiarani J. et al. Compos. C: Open Access 2021, 100164

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