Nanoparticles from biological source and polymer nanocomposites

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Unexpected and attractive properties can be observed when decreasing the size of a material down to the nanoscale. Polysaccharides, an important class of biological polymers, are no exception to the rule. In addition, structural polysaccharides, such as cellulose and chitin, or storage polysaccharides, such as starch, have a highly reactive surface resulting from the high density of hydroxyl groups which is exacerbated at this scale. As is usually the case when a new field is developing, the terminology is somewhat confused, but the term "nanocellulose" is now used to cover the range of materials derived from cellulose with at least one dimension in the nanometer range. Different forms of cellulose nanomaterials, resulting from a top-down deconstructing strategy (cellulose nanocrystals-CNC, cellulose nanofibrils-CNF) or bottom-up strategy (bacterial cellulose) can be prepared [1]. Strong acid hydrolysis of cellulose fibers, a process reported in the 1940s [2], is generally used to isolate CNC (Fig. 1a). A top-down mechanically-induced destructuration of cellulose fibers can be induced by submitting slurries to high shear forces to release more or less individual CNF (Fig. 1b), as described in the 1980s [3]. These nanomaterials have been academic curiosities for many years. There is today a substantial amount of research on these cellulosic nanomaterials, and commercial development is underway with some promising applications. These include paper and cardboard industry, use as reinforcement for nanocomposites, basis for low-density foams, additive in adhesives and paints, as well as a wide variety of filtration, electronic, food, hygiene, cosmetic, and medical products.

References

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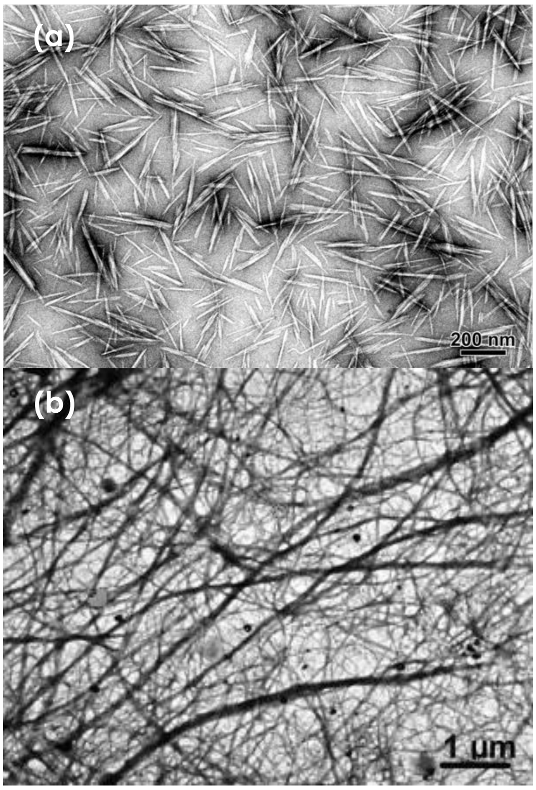

Figure 1: TEM from a dilute suspension of (a) CNC extracted from ramie [4], and (b) CNF prepared from *Opuntia ficus-indica* [5].