Nanocellulose – properties and possibilities

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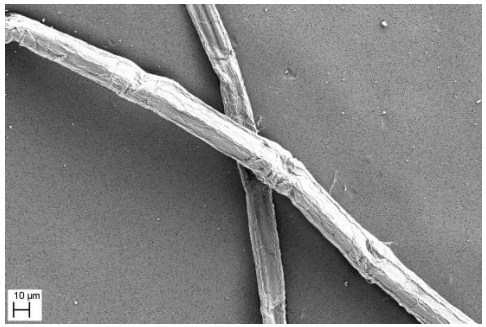
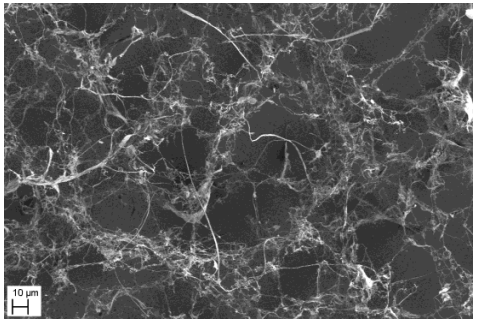
Kokkola Material Week
BioKokkola 31.10.2017

Nanofibrils and -crystals

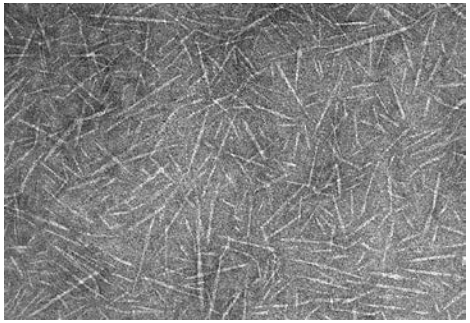
NFC MFC CNF CMF NCC



Cellulose fibre

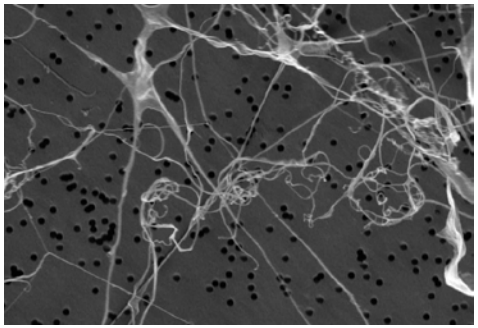


MicroFIBRILS (MFC)



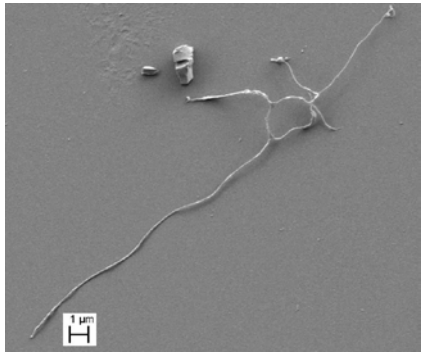
100 nm

NanoCRYSTALS (CNC)



1 µm

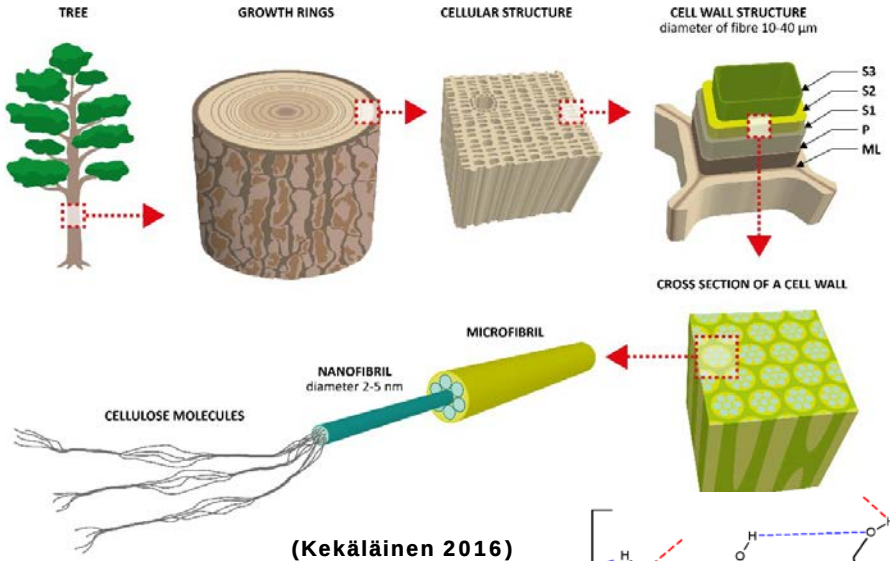
Micro- and nanoFIBRILS (MFC / NFC)



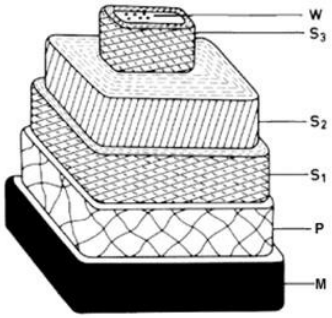
MicroFIBRIL (MFC)

	Width [nm]	Length [nm]
NFC	2 - 5	500 → some µm
NCC	2 - 15	100 - 500

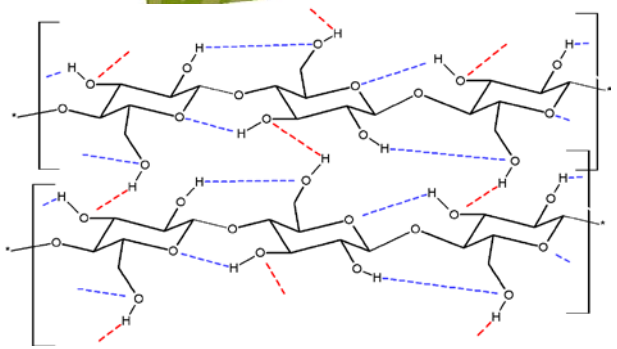
Tree as a nanocellulose source



(Kekäläinen 2016)



Fibre wall structure width 10-40 µm
(Puukemia 1977, Jensen)



Hydrogen bonds in wood based cellulose

Nanocellulose properties

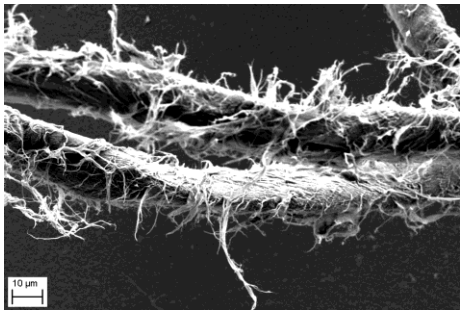
- Light weight
- Strength
- Water absorption capasity
- Hydrogen bonding tendency
- Optical properties
- Barrier properties

Nanocellulose - production

- Ultra-fine grinder
- High pressure homogenizer
- Microfluidizer

- High energy demand
- Clogging of devices

- Ultra-sonic treatments
- Steam explosion



- Fibre structure loosens
- Crystals by hydrolysis

- Amount of water

Possibilities – raw material

- Wood fibres
  - pine, spruce
  - birch, eucalyptus

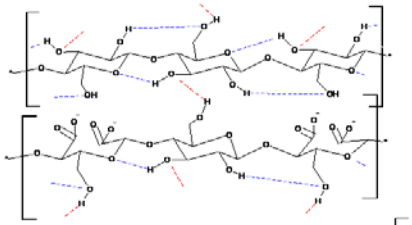
- Non-wood fibres
  - cotton, jute, sisal, wheat straw

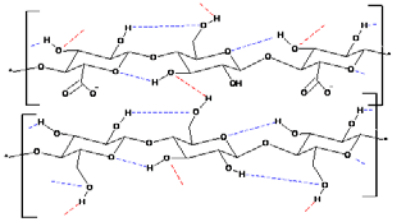
- Tunicates, algae

- Side streams
  - pulp and paper industry
  - food/beverage industry

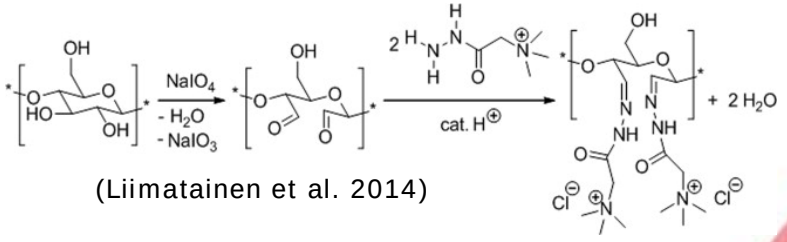
Possibilities - chemistry

- Anionic
  - Carboxyl group
  - Carboxymethyl group





- Cationic
  - Quaternary ammonium groups
- Hydrophobic
  - Esterification
  - Acetylation



(Liimatainen et al. 2014)

- Grafting

Nanocellulose – possibilities

- Raw material + mechanical forces + chemistry
- Mixing with other materials
  - Nanomaterials
  - Wood components

What is enough for desired application?

- Hydrogels, aerogels, films, foams..
- Medical applications, photonics, paints, paper and packaging, electronic sensors, 3D-printing, car components, water purification..
- Increase strength, modify rheology, insulate, improve barrier properties, absorb water, increase porosity..

Thank you!

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