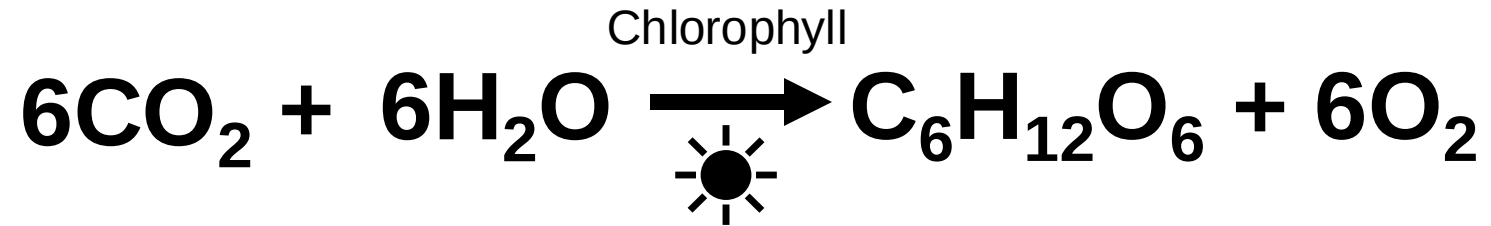


Steve Eichhorn

Professor of Materials
Science and
Engineering

Cellulose: Nature's Wonder Material for Composites and Other Applications

Where does cellulose come from?



Spring



Summer



Autumn

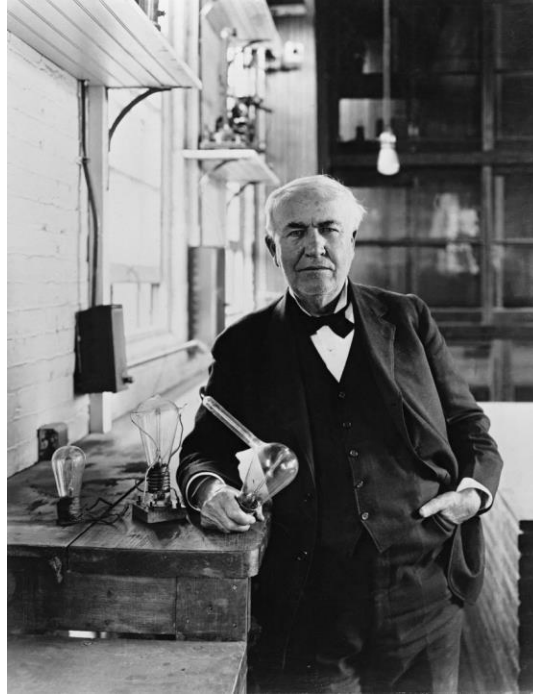


Winter

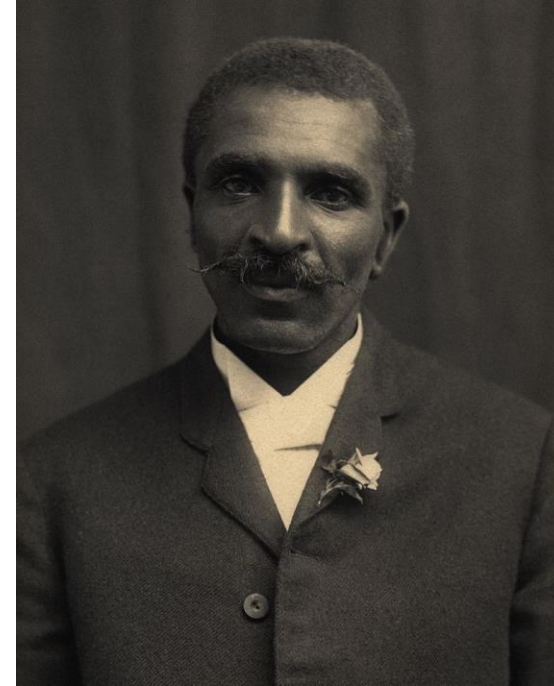
Black History Month – Cellulose Based Composites



Henry Ford



Thomas Edison



George Washington Carver



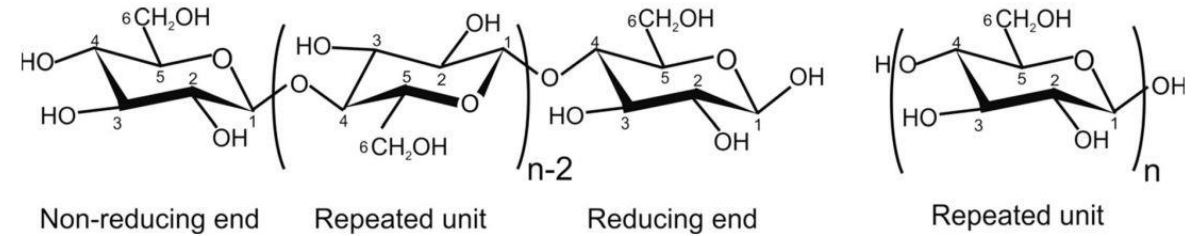
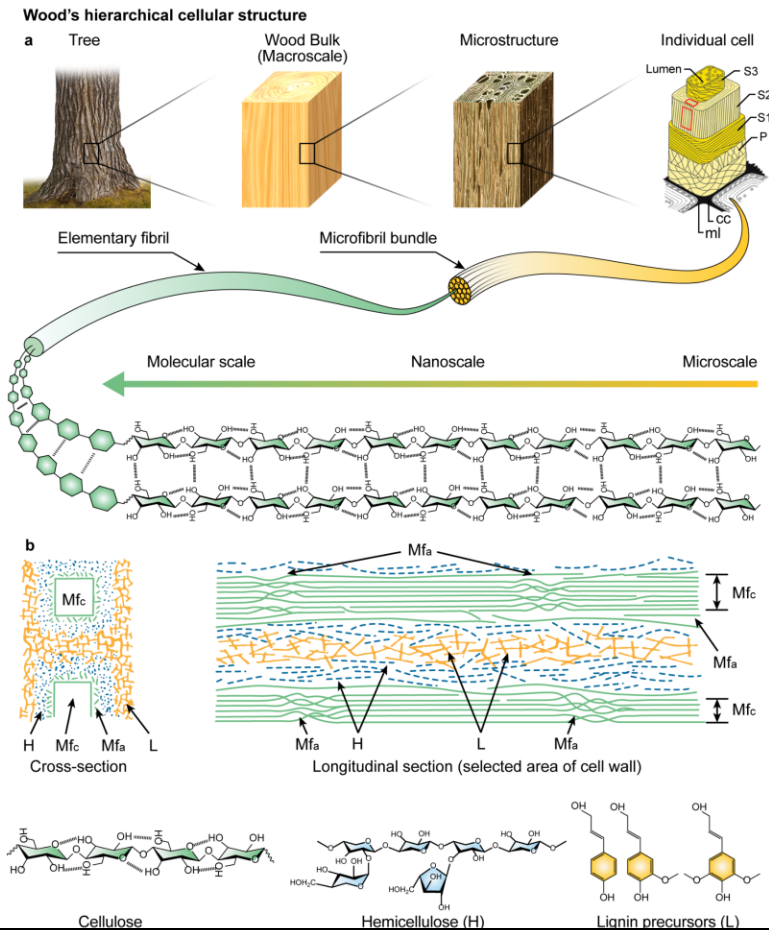
Howard Latimer

<https://celbiocompedi.com/> “Realising Functional Cellulosic Bio-based Composites” EPSRC Fellowship

“Reclaiming Narratives”



What is its structure?



French AD (2017) Glucose, not cellobiose, is the repeating unit of cellulose and why that is important. Cellulose **24:4605-4609**

Cellulose occurs in plants mainly as type-I

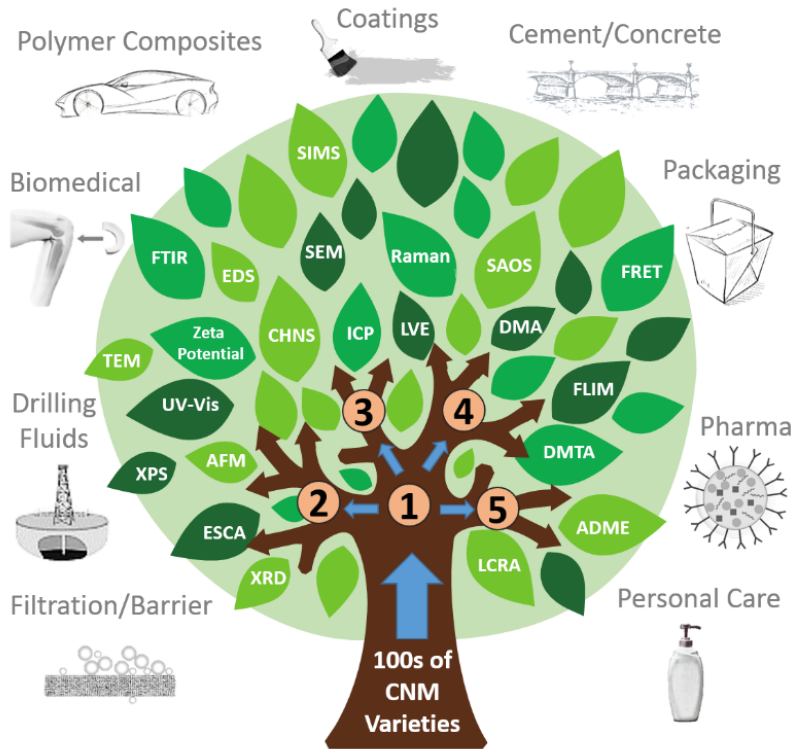
Parallel chain structure

2 sub-allomorphs in cellulose-I (plant cellulose); namely I α and I β

Chen *et al.* *Nature Reviews Materials*, **5**, 642–666 (2020).

Cellulose Nanomaterials

Current Methods for Cellulose Nanomaterial Characterization:



1 Identifying the CNM Type You Are Working With

Section 2: Know your starting material: handling, drying and redispersing CNM and suspension properties

2 Particles and Their Surfaces

Section 3: Determination of CNM surface charge density
 Section 4: Elemental analysis of CNMs
 Section 5: Solid state properties of CNMs
 Section 6: Surface modification characterization of CNMs
 Section 7: Electron microscopy of CNMs

3 Interaction With Environment

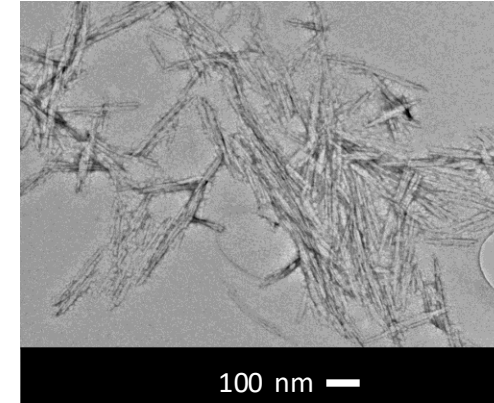
Section 8: Rheology of CNMs
 Section 9: Preparation of CNM thin films for: particle size analysis and optical, surface forces and adsorption studies

4 Effects in Polymers

Section 10: Fluorescence labeling of CNMs for structure and dynamics characterization
 Section 11: Mechanical properties of CNM composites and interfaces

5 Impacts on Health & Safety

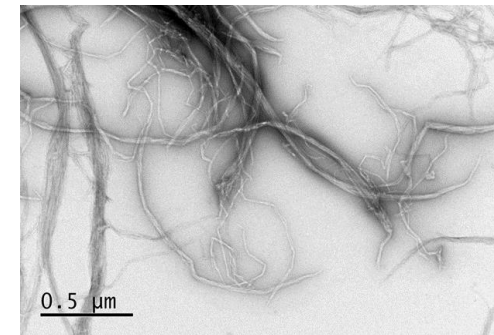
Section 12: Health/safety characterization methods



Cellulose nanocrystals



'Rice like'



Cellulose nanofibrils

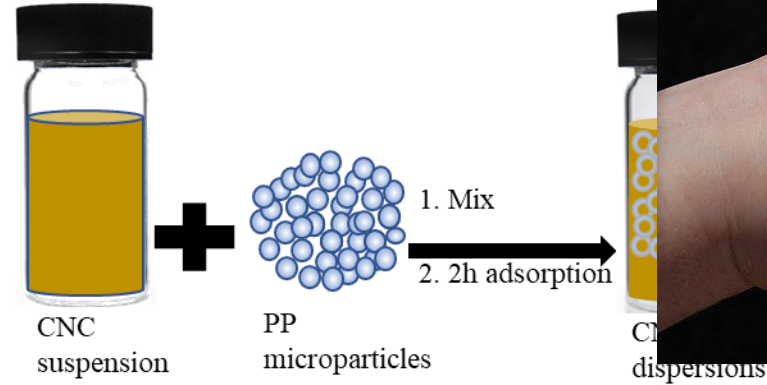
(Carbohydrate Polymers 2024 **344** 122519)

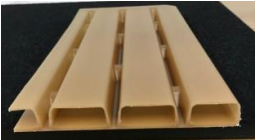
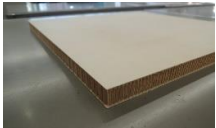


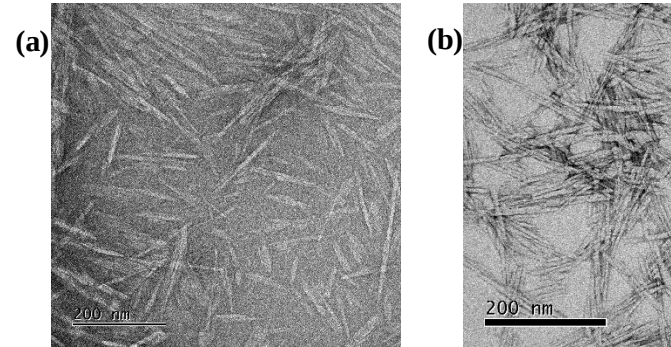
'Noodle like'

Foster....Eichhorn....*et al.* Chemical Society Reviews 2018 **47** 2609-2679

Composites Using Nanocellulose



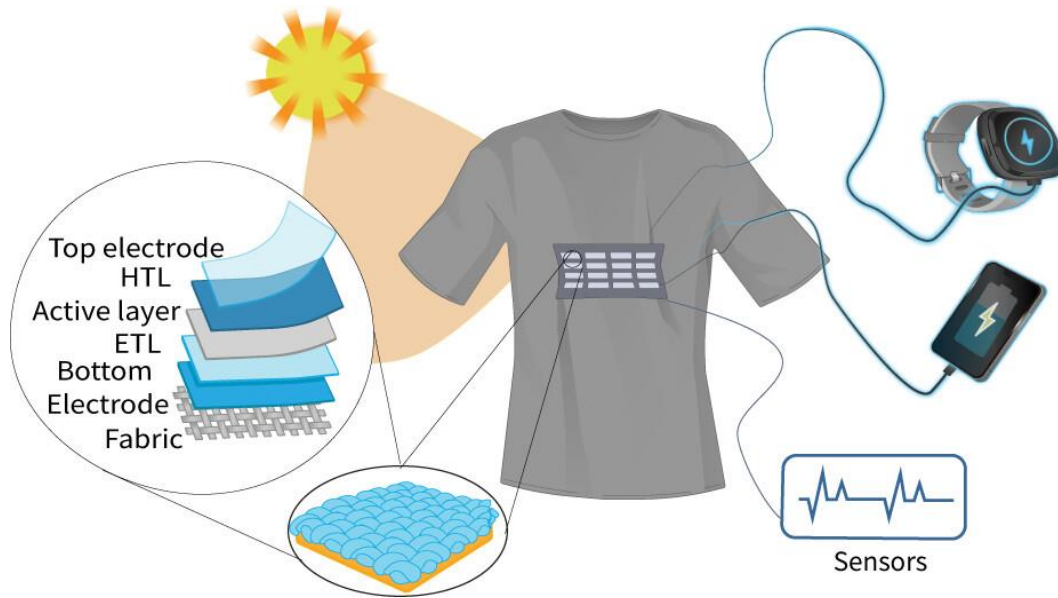
KYORAKU KYORAKU Co. Ltd. PP-CNF10% Blow molding  Deck board	 SHOWA MARUTSUTSU Co. Ltd.  100% CNF beam
RISHO RISHO KOGYOU Co. Ltd.  100%-CNF Honeycomb board	maxell Maxell holdings Ltd Within the Future PA6-CNF5% Metal plated PA6 molding 



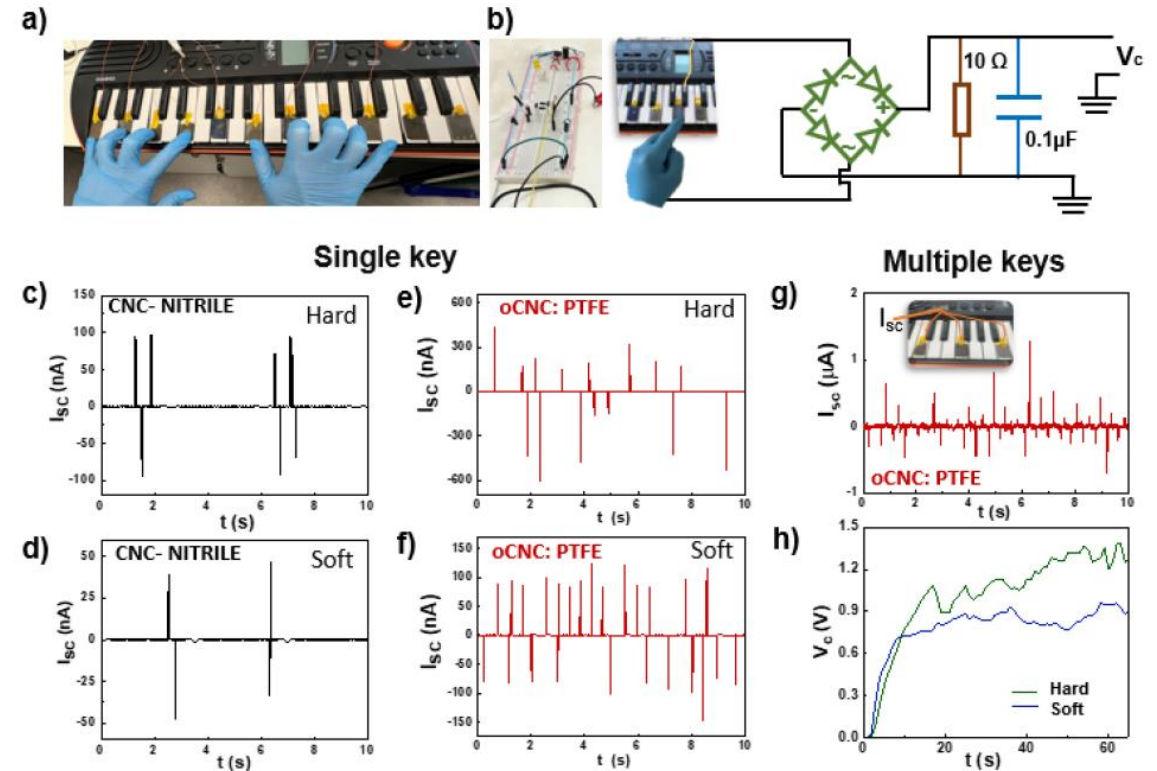
Onyianta et al. (2022) "Amphiphilic processing of thermoplastics" A



Energy Harvesting and Storage Using Nanocellulose



Ali, Islam, Yin, Eichhorn, Chen, Karim & Afroj *ACS Nano* **8** 3871-3915



Alghamdi, Morgan, Russo....., Eichhorn, Craciun [submitted]

THANK YOU FOR YOUR ATTENTION

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