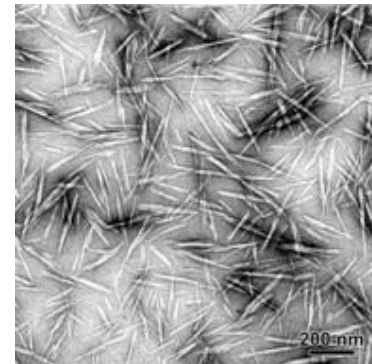
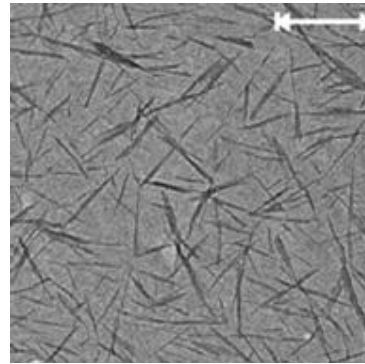
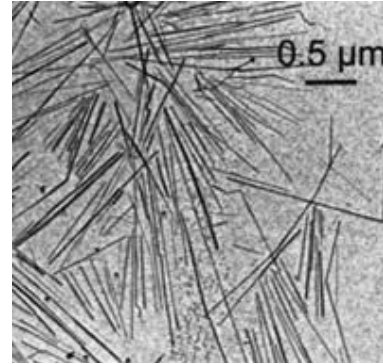
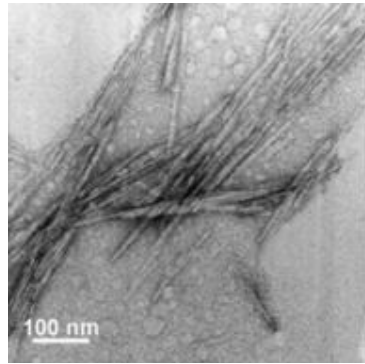


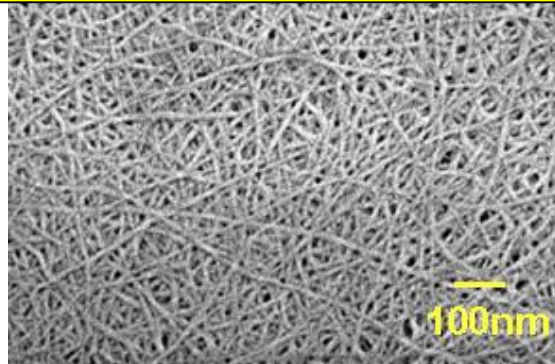
# **WG2: Science and Use of Nanocellulose**

Steve Eichhorn (University of Exeter)

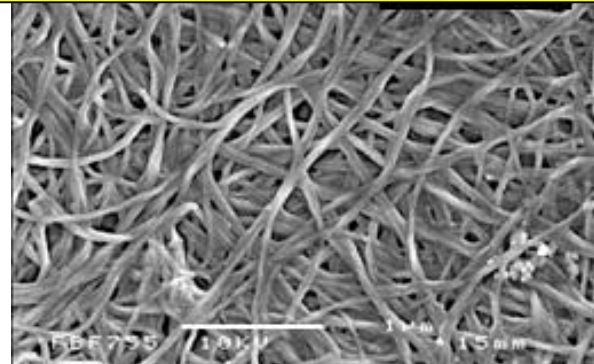


## CNWs

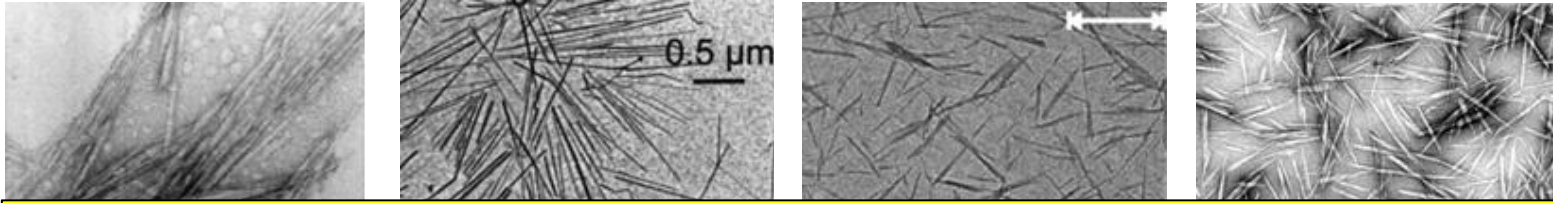
Eichhorn, S.J., Dufresne, A., Aranguren, M., Marcovich, N.E., Capadona, J.R., Rowan, S.J., Weder, C., Thielemans, W., Roman, M., Renneckar, S., Gindl, W., Veigel, Yano, H., Abe, K., Nogi, M., Nakagaito, A.N., Mangalam, A., Simonsen, J., Benight, A.S., Bismarck, A., Berglund, L.A., Peijs, T. 2010. Current International Research Into Cellulose Nanofibres and Nanocomposites. *Journal of Materials Science*, **45**, 1-13.



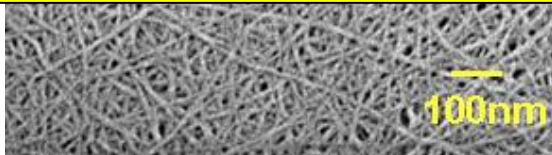
## MFC



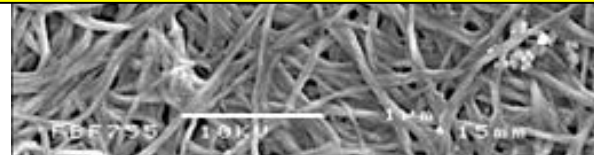
## Bacterial Cellulose



What are the physical properties of nanocellulose fibres?  
How can we produce them more **cheaply** and in **larger quantities**?  
Can nanocellulose fibres compete with traditional materials?  
What about interfaces?  
Thermoplastic processing?  
What about moisture?  
What nanofibres should we use for what applications?  
MFC vs BC vs CNWs ?  
Large volume applications?  
End-users?  
Industrial success story?



**MFC**



**Bacterial Cellulose**

# Important properties of cellulose

- We know that cellulose is stiff....(high  $E$ , high  $\sigma$ )
- We know that cellulose is light...(low  $\rho$ )
- We know that cellulose is cheap...(low £\$)
- We know that cellulose is renewable...

**In engineering/industrial terms it should be easy to sell these properties**

# Modulus of Cellulose Nanofibres

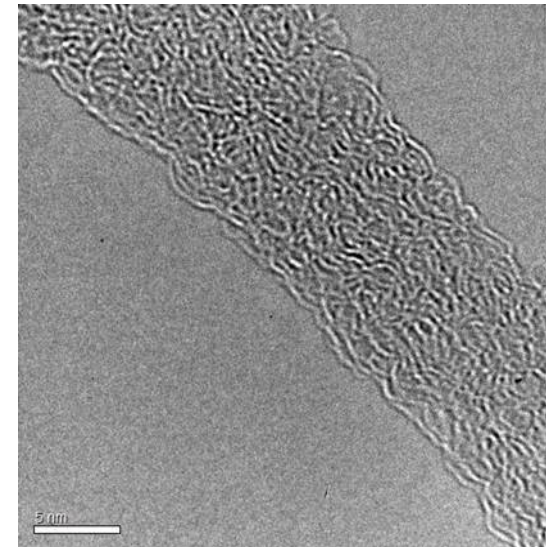
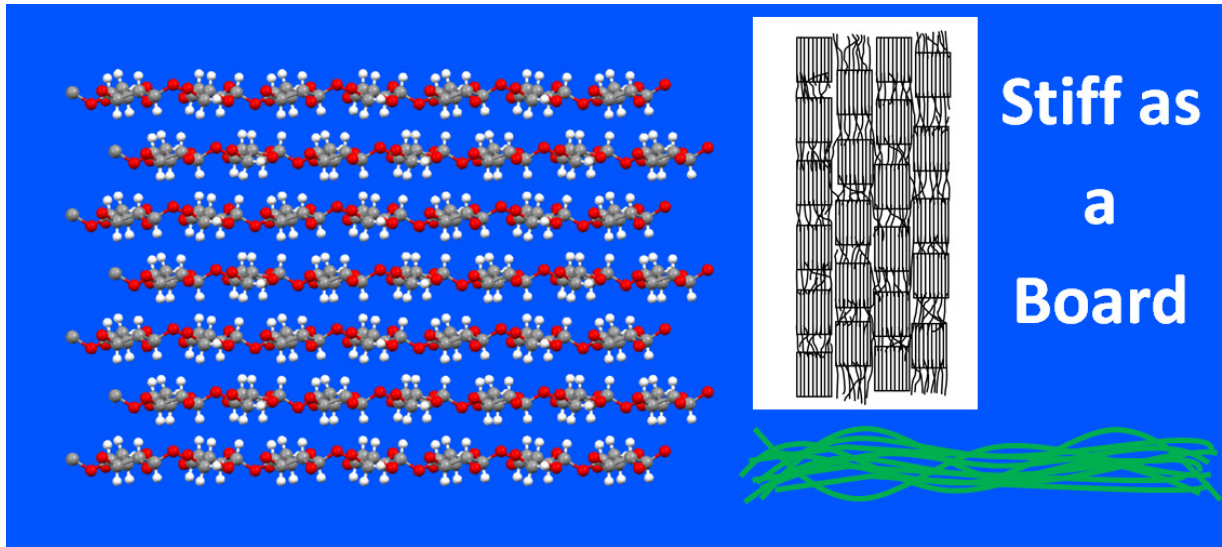
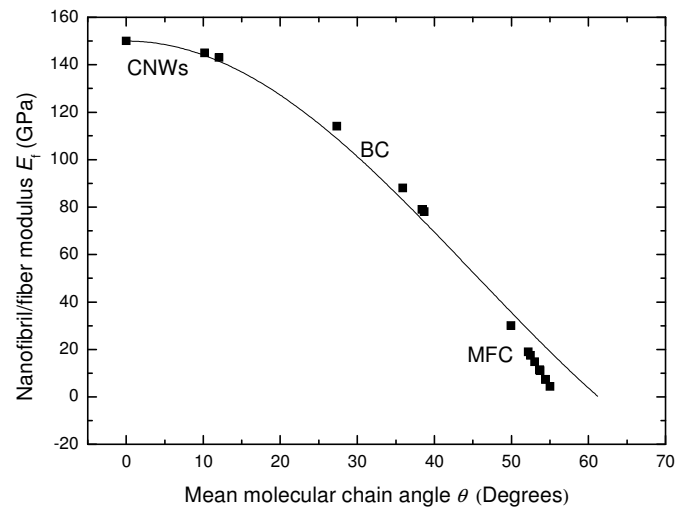


Image courtesy of B.S.Hsaio



- Crystallinity of some cellulose nanofibres are found to be low (20-50%)
- Modulus of cellulose nanofibres often just quoted as 137 GPa (Sakurada et al.)
- Need to look at sub-fibrillar structure-processing relationships

Eichhorn, *ACS Macro Letters* (2012) **1**, 1237-1239