

# How electrolytes vary the suspension structure of cellulose nanocrystals

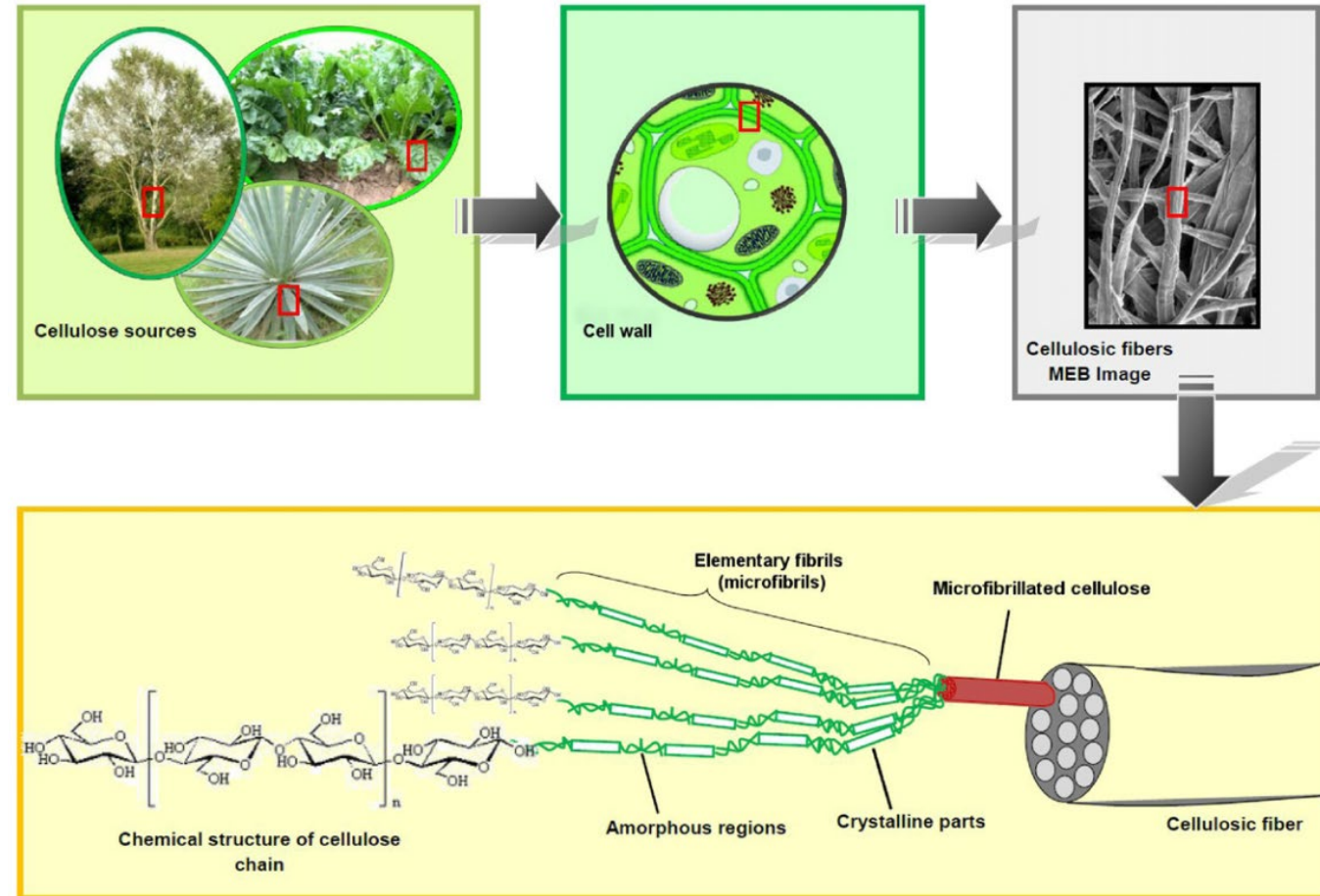
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Bioresource Processing Research Institute of Australia (BioPRIA)  
Department of Chemical and Biological Engineering  
Monash University



# Cellulose

- Naturally abundant polymer
- Trees, crops, etc.
- Biodegradable
- Environmentally friendly
- Recyclable
- Fully renewable
- Green economy backbone



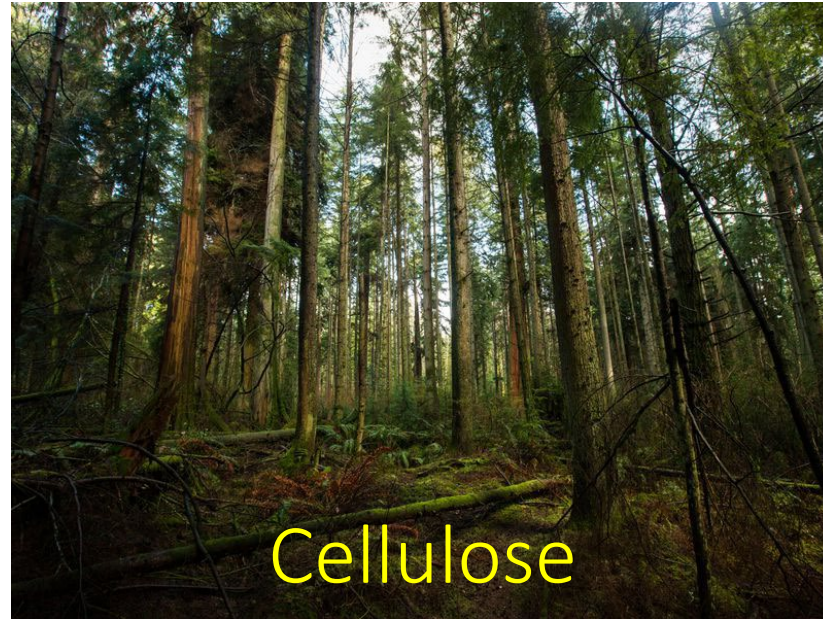
**Textile**



**Gels**

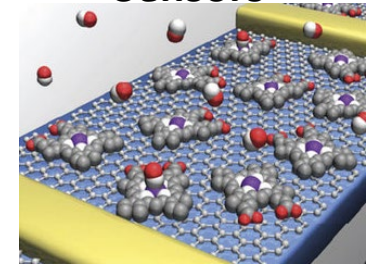


**Paper**



**Cellulose**

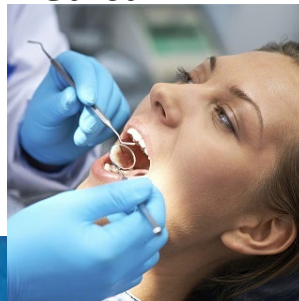
**Sensors**



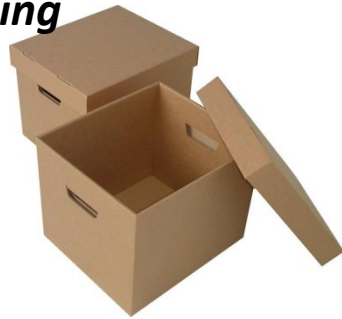
**Food**



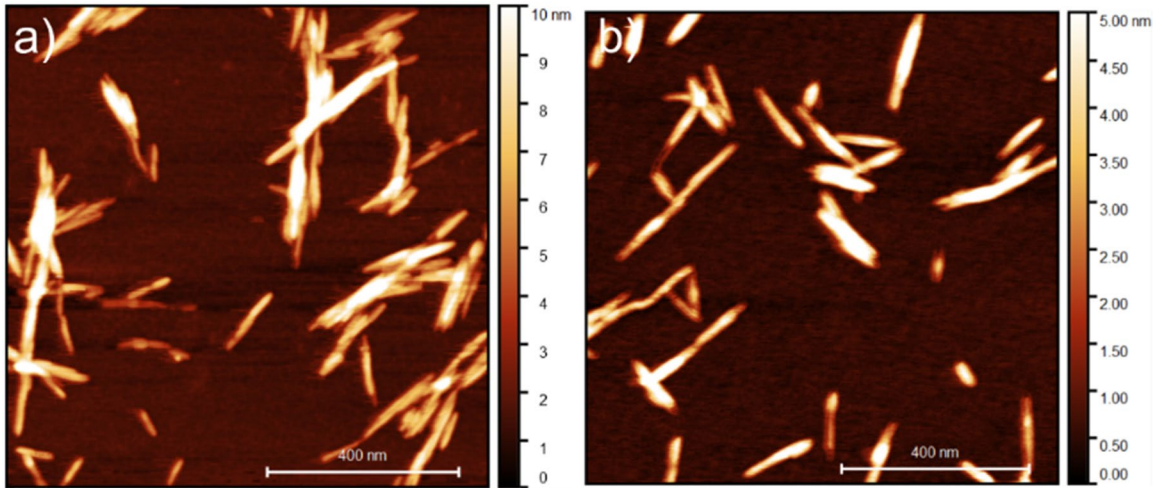
**Medical**



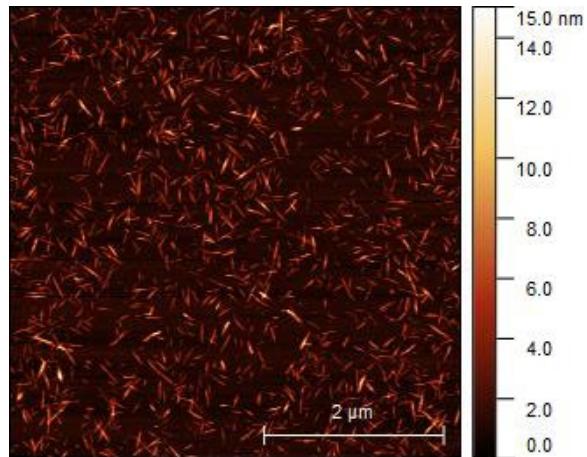
**Packaging**



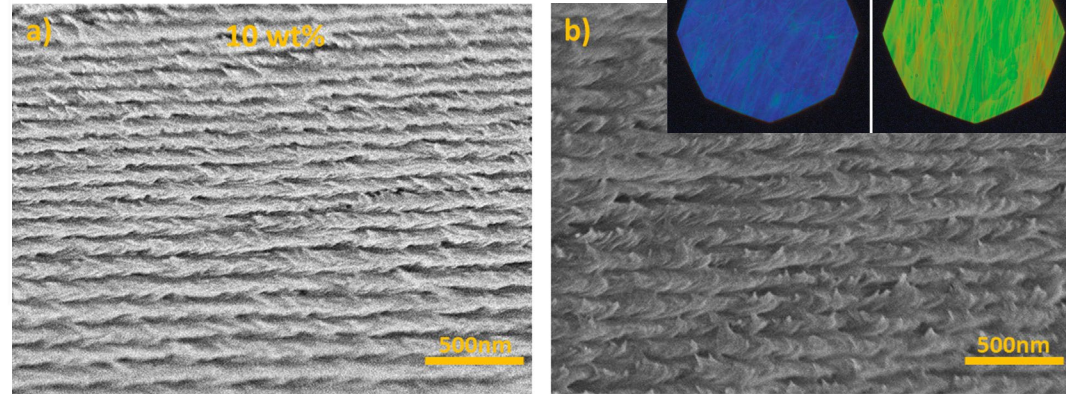
# Chiral nematic structures of CNC



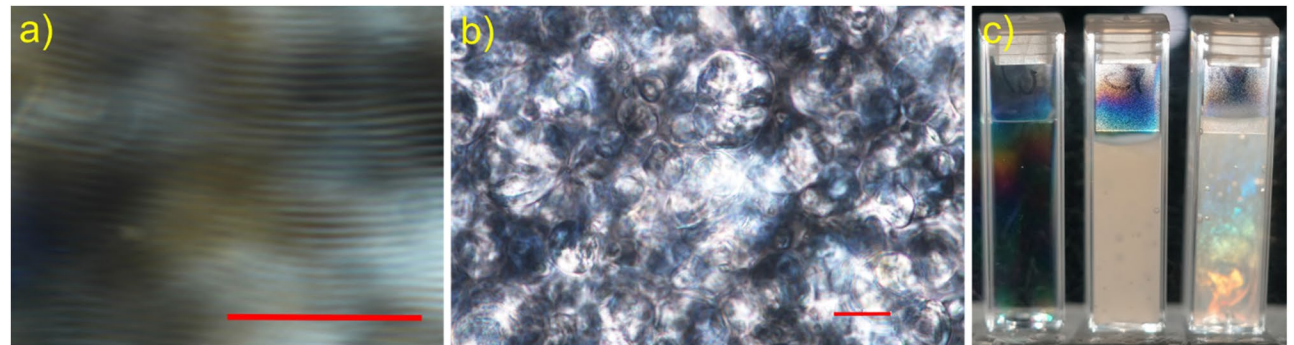
Length 100 nm  
Diameter 5 nm



## Films



## Suspension

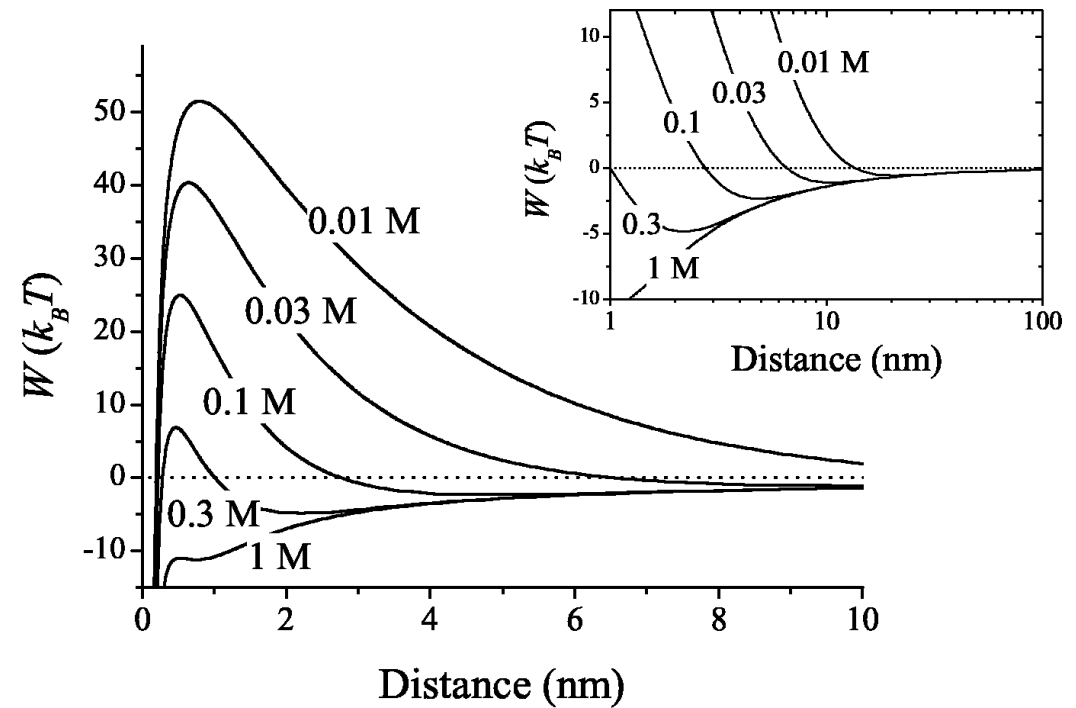
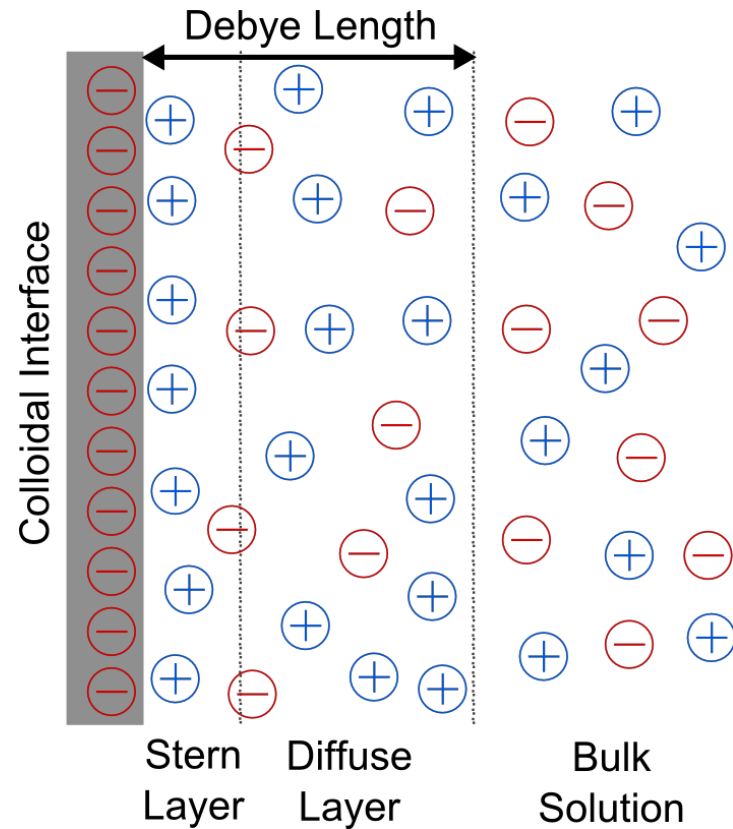


C. Browne, et al. Colloid Surf A, 2022, 651, 129532.

M. Lin, et al. JCIS, 2021, 584, 216-224.

B.E. Droquet, Nat. Mater., 2022, 21(3), 352-358

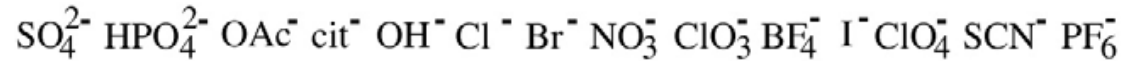
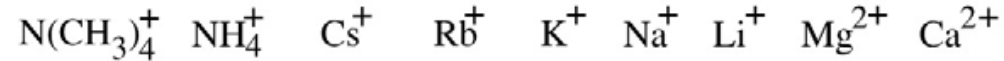
# Electrolyte addition



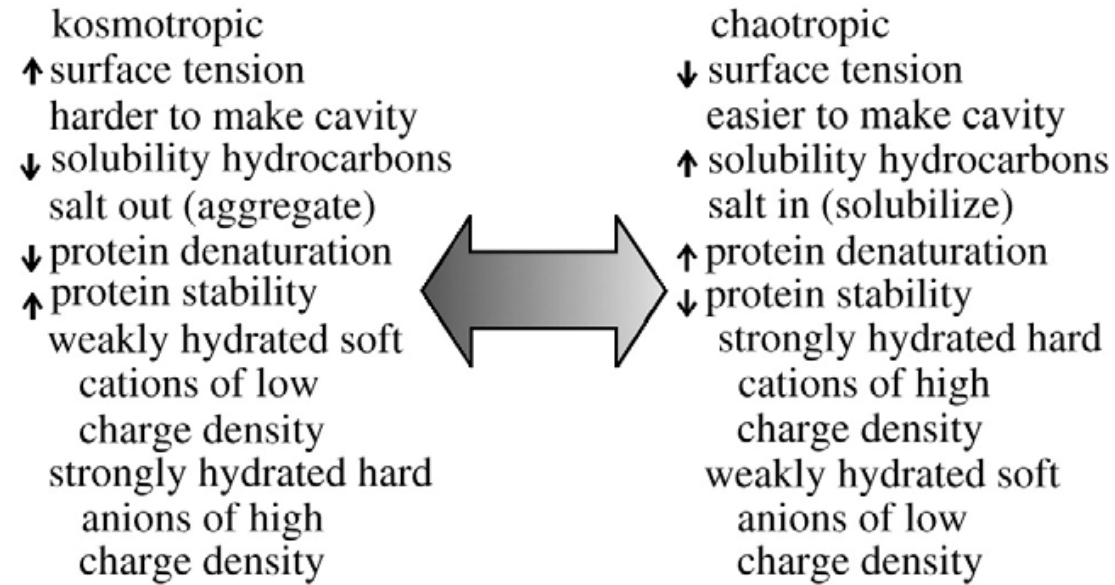
# Specific Ion Effects

## HOFMEISTER SERIES

### Cations



### Anions



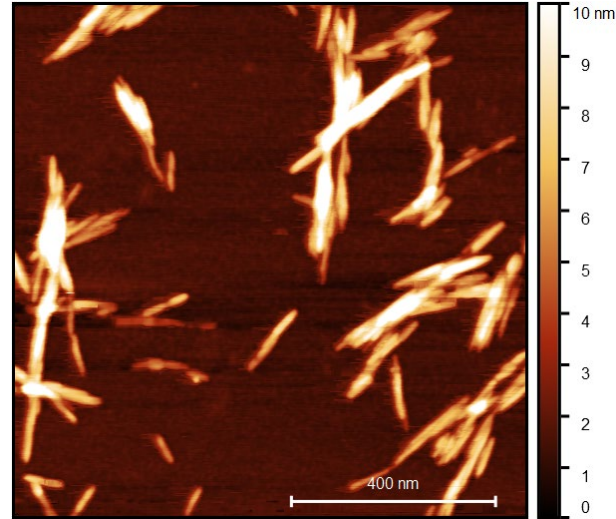
What role does electrolyte concentration, type and valency play on the suspension structure of CNC?

# CNC Properties

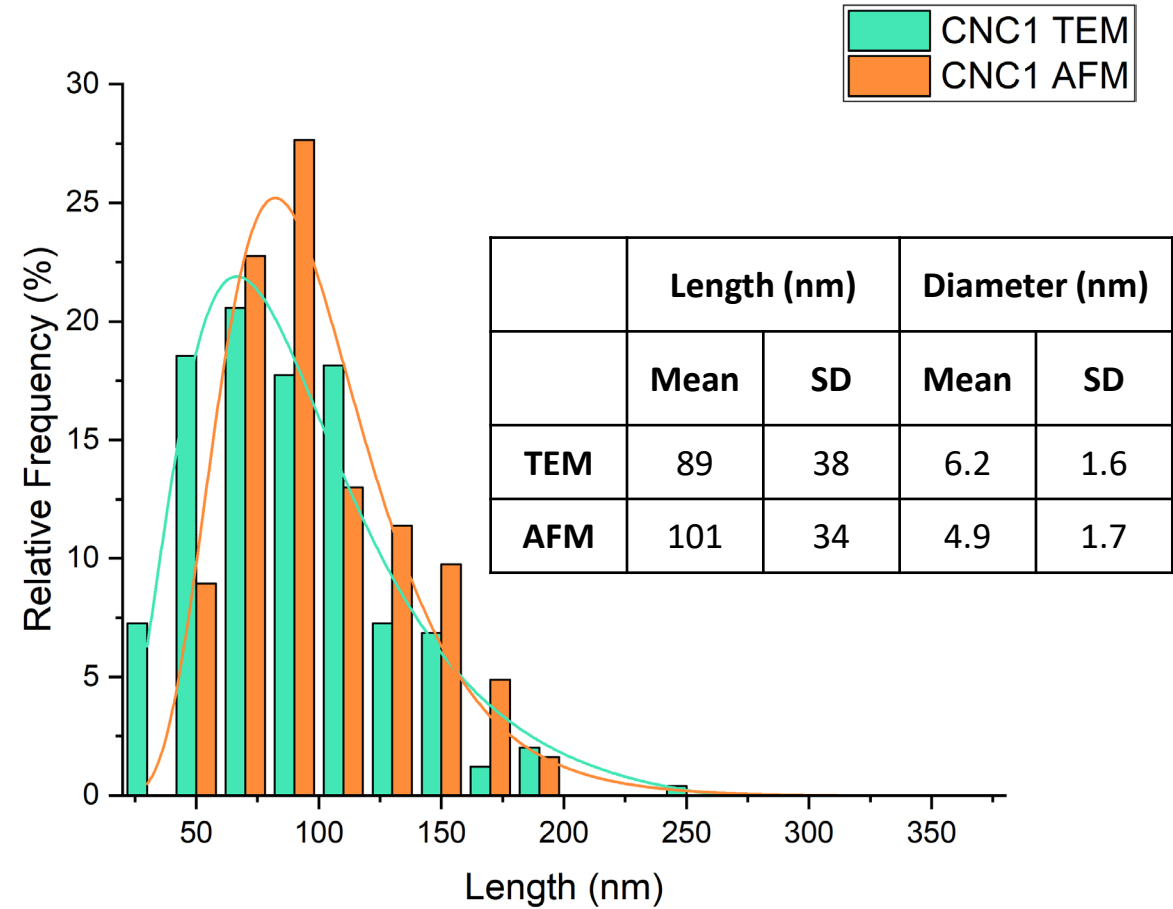
- Sulfur content –  $0.73 \pm 0.09$  wt%
- Zeta potential -  $-52 \pm 8$  mV



TEM



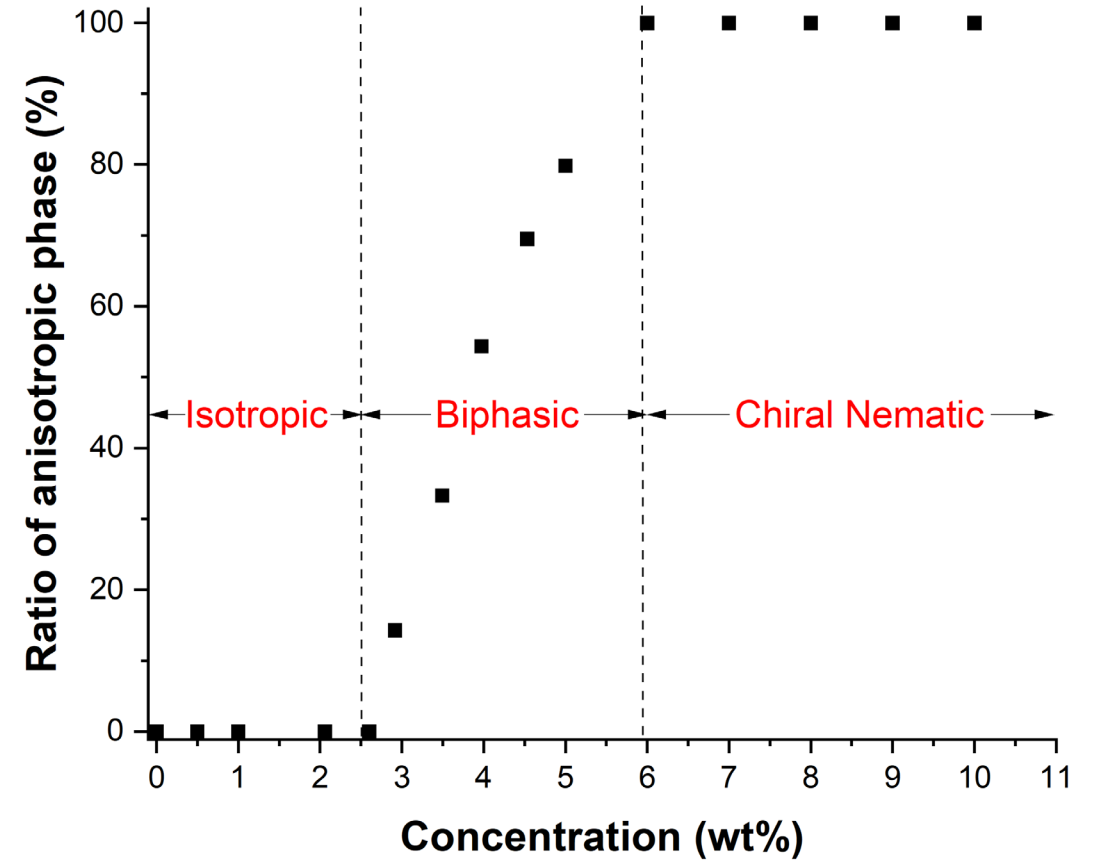
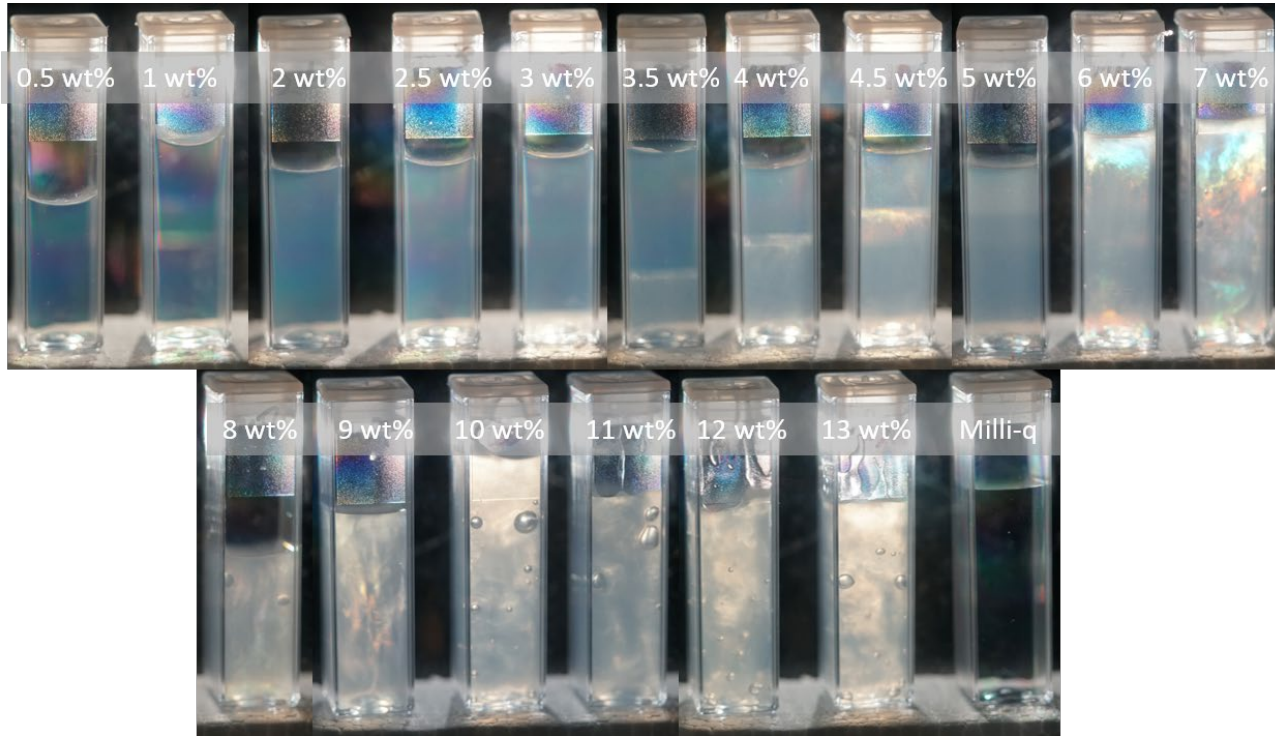
AFM





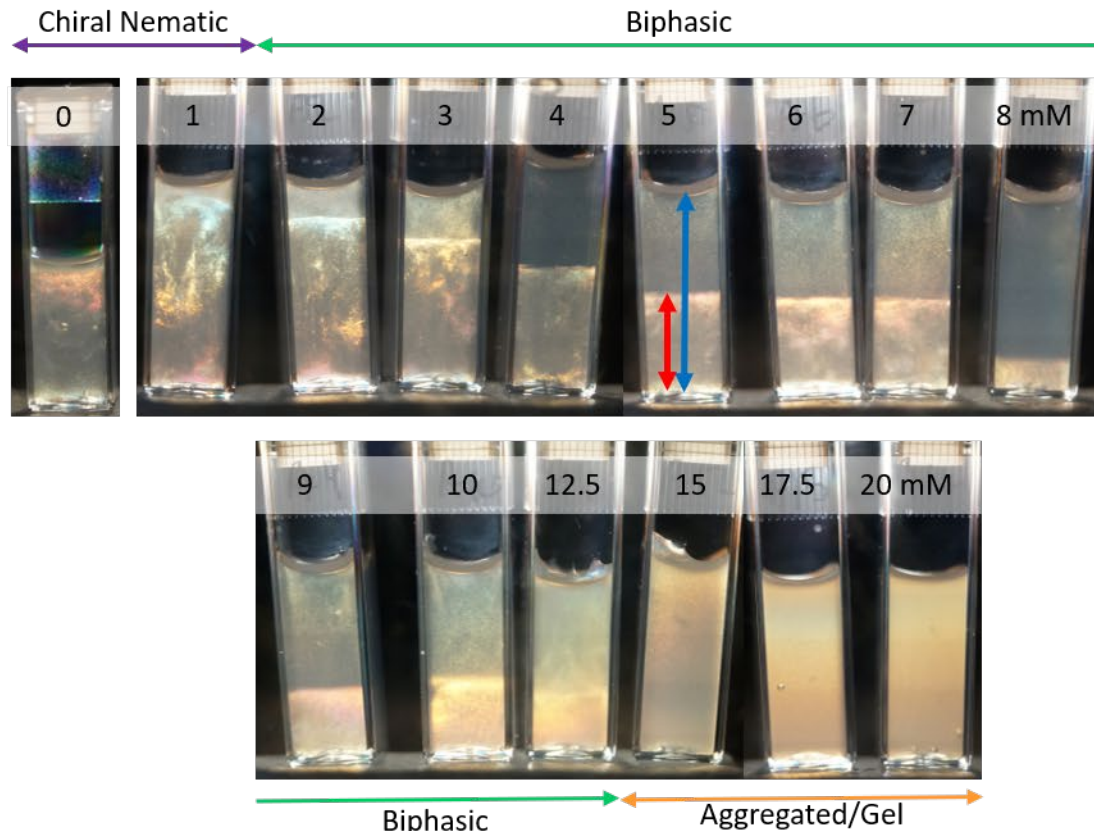
# Polarised Optical Photography (POP)

## CNC concentration

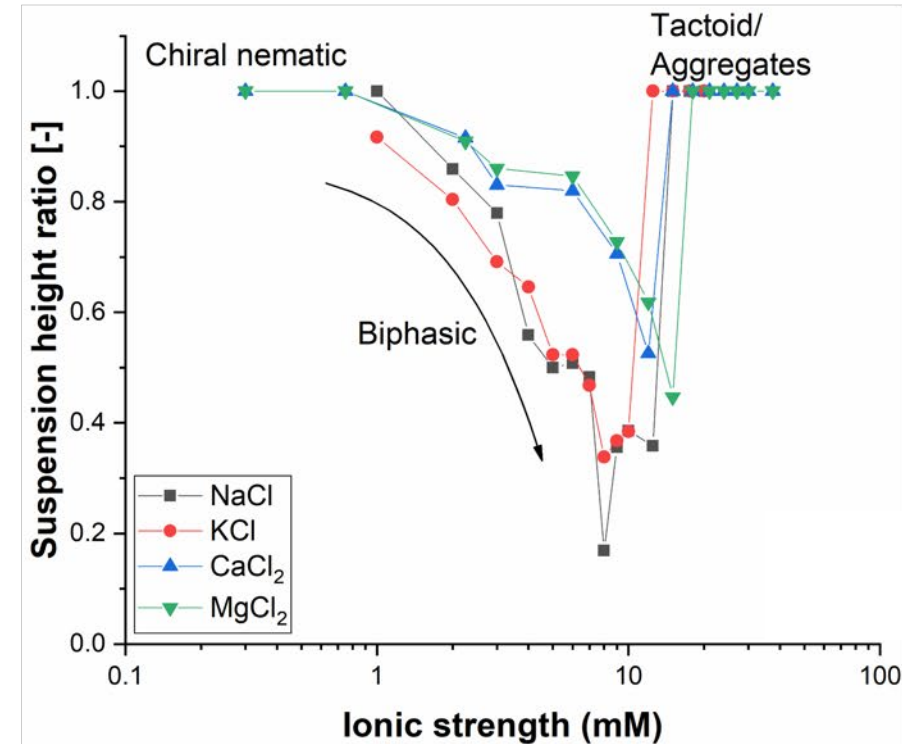


# Polarised Optical Photography

## NaCl concentration

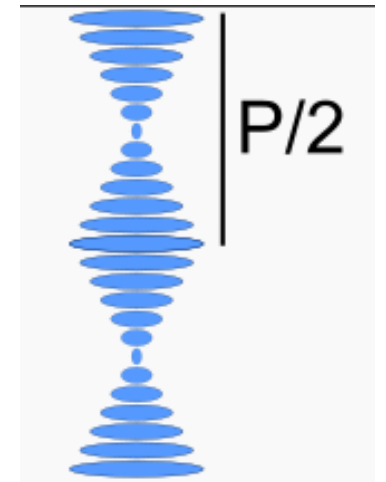
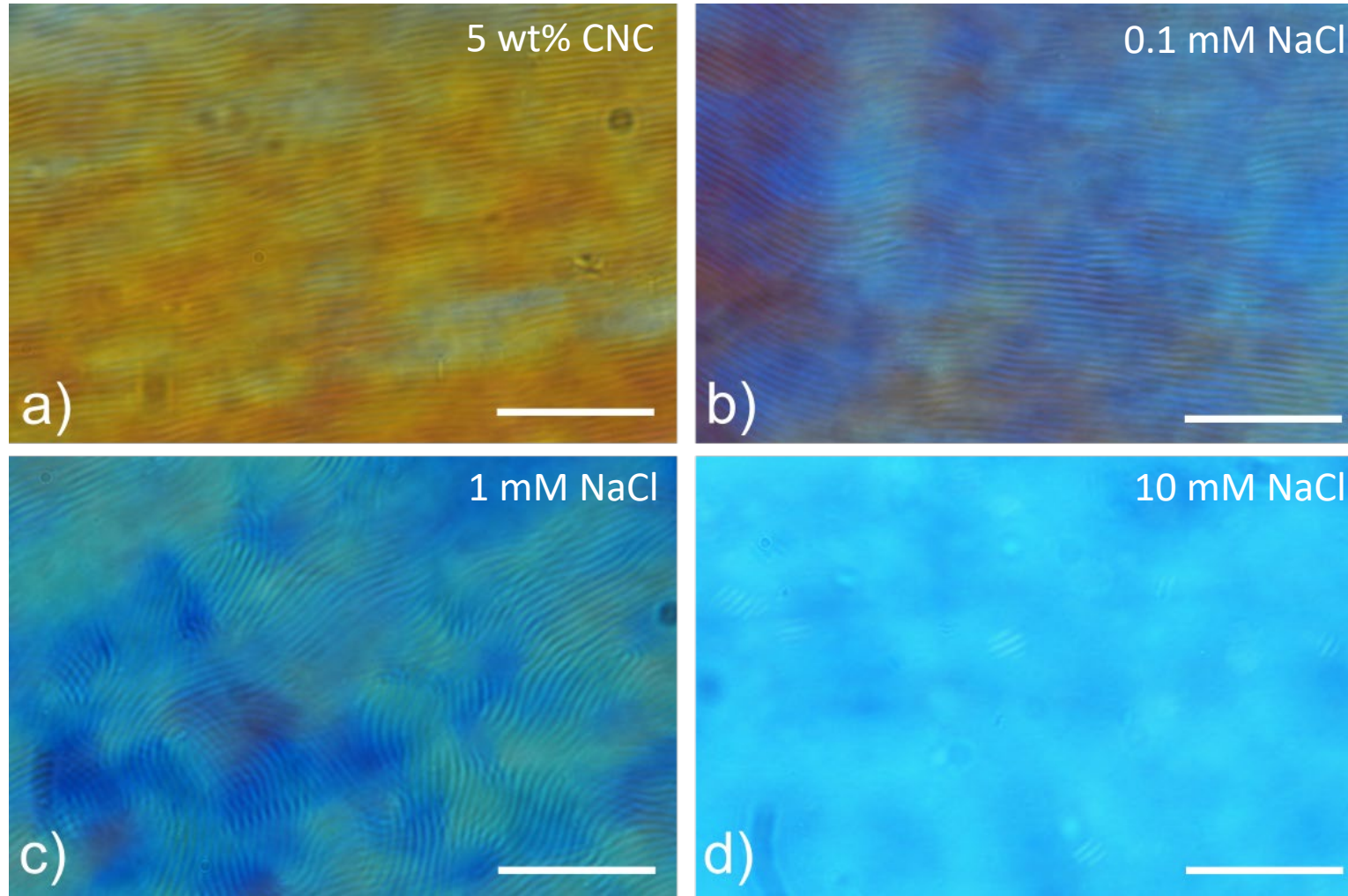


5 wt% CNC + NaCl



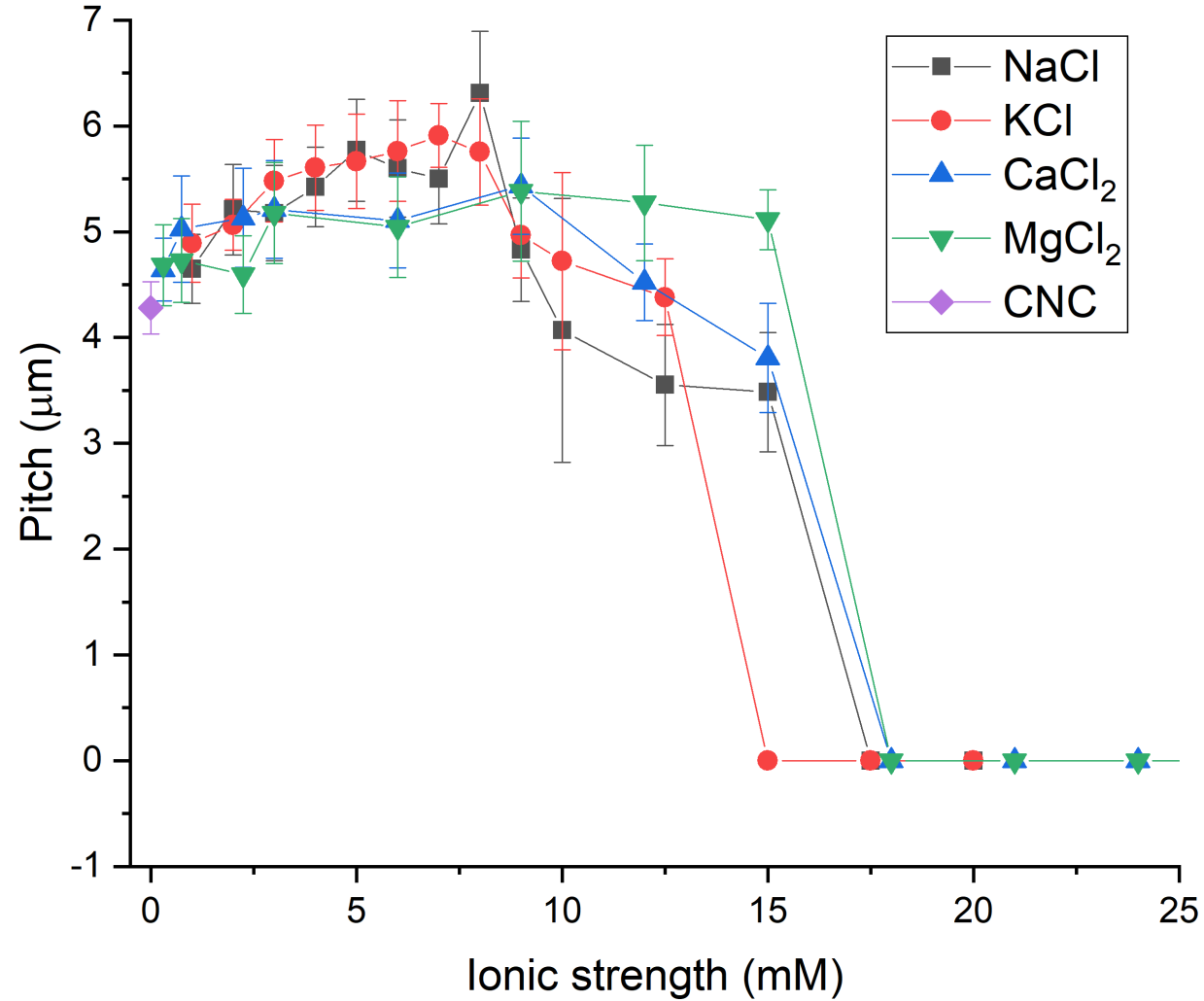
NaCl  
KCl  
CaCl<sub>2</sub>  
MgCl<sub>2</sub>

# Polarised Optical Microscopy



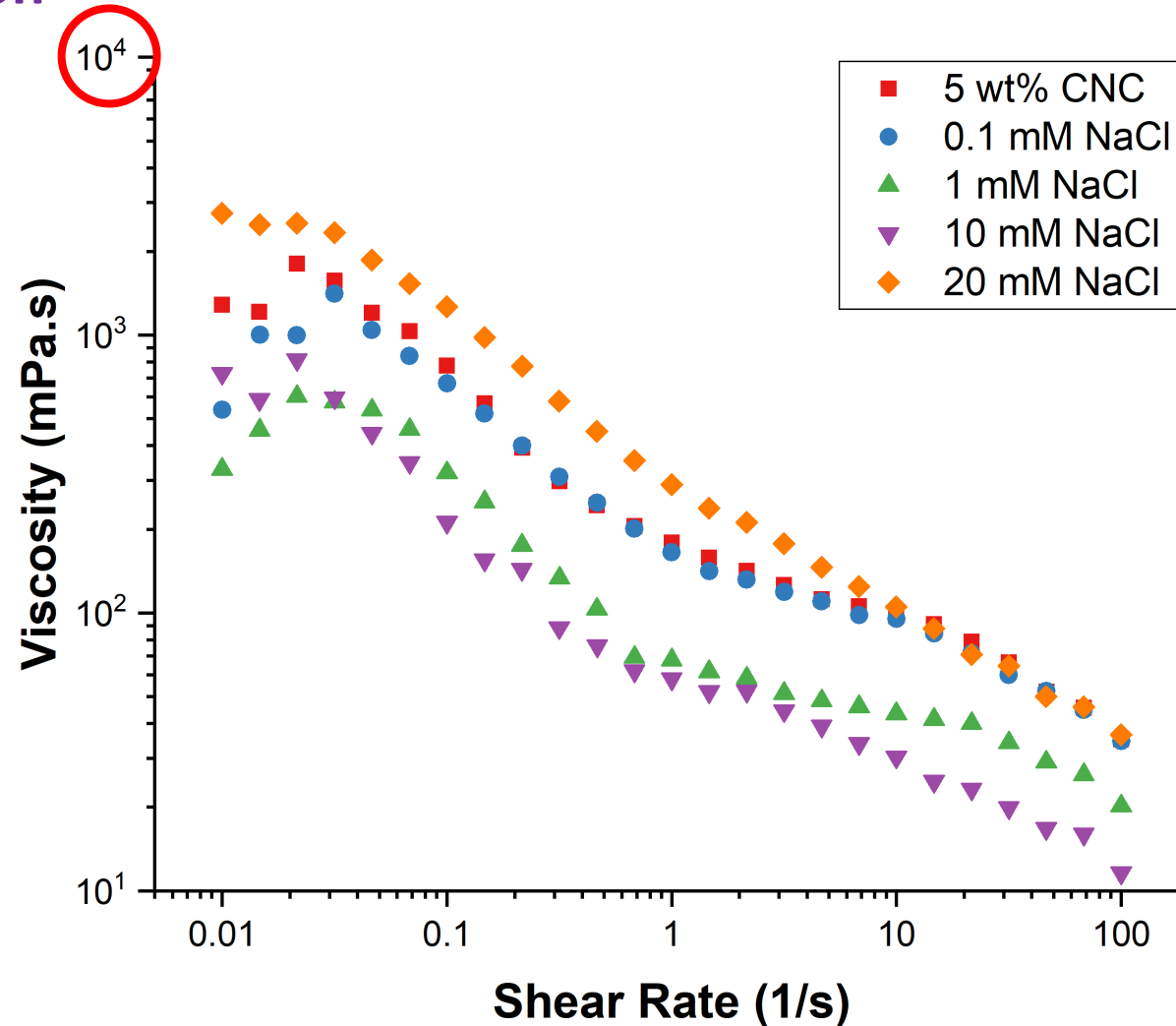
Scale bar – 40  $\mu\text{m}$

# Pitch verses ionic strength



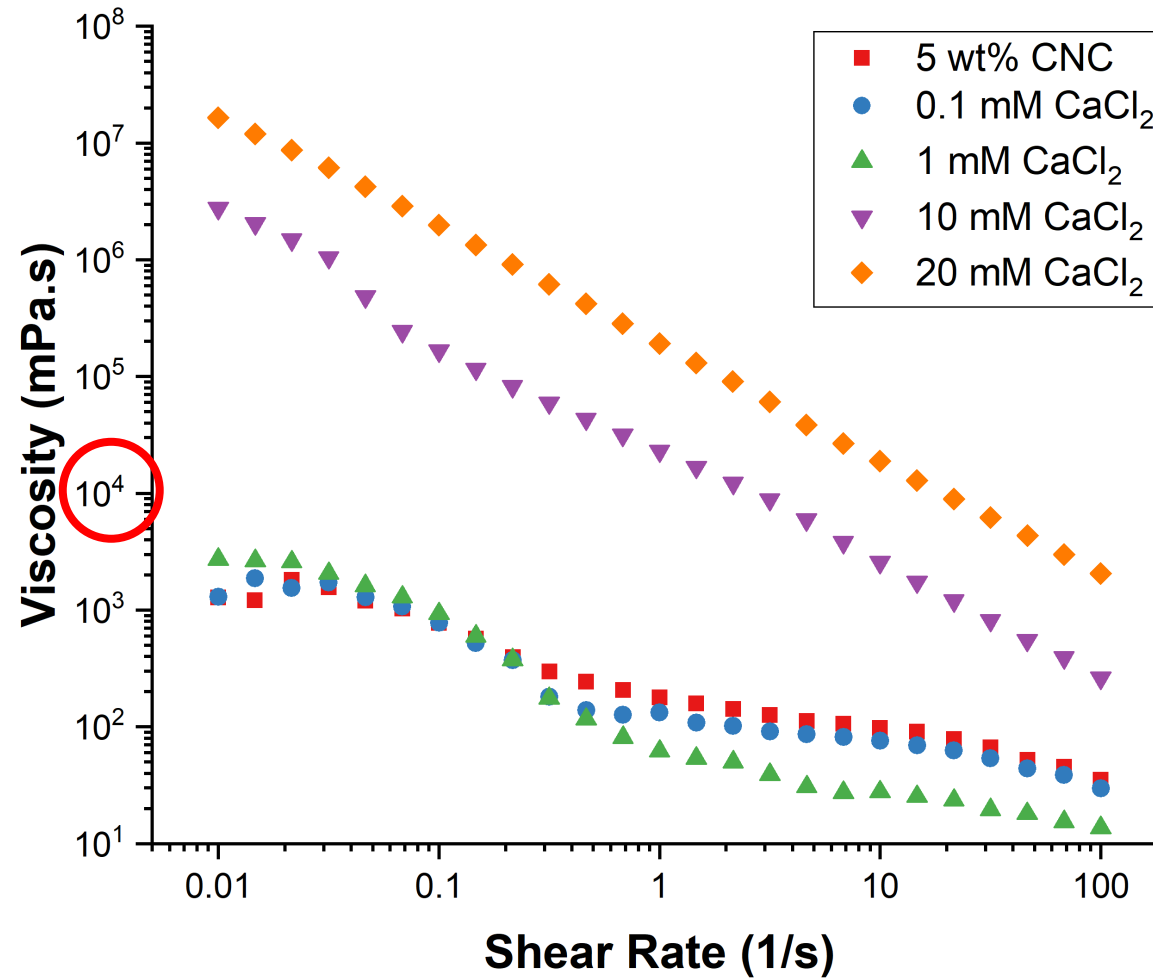
# Suspension rheology

NaCl concentration

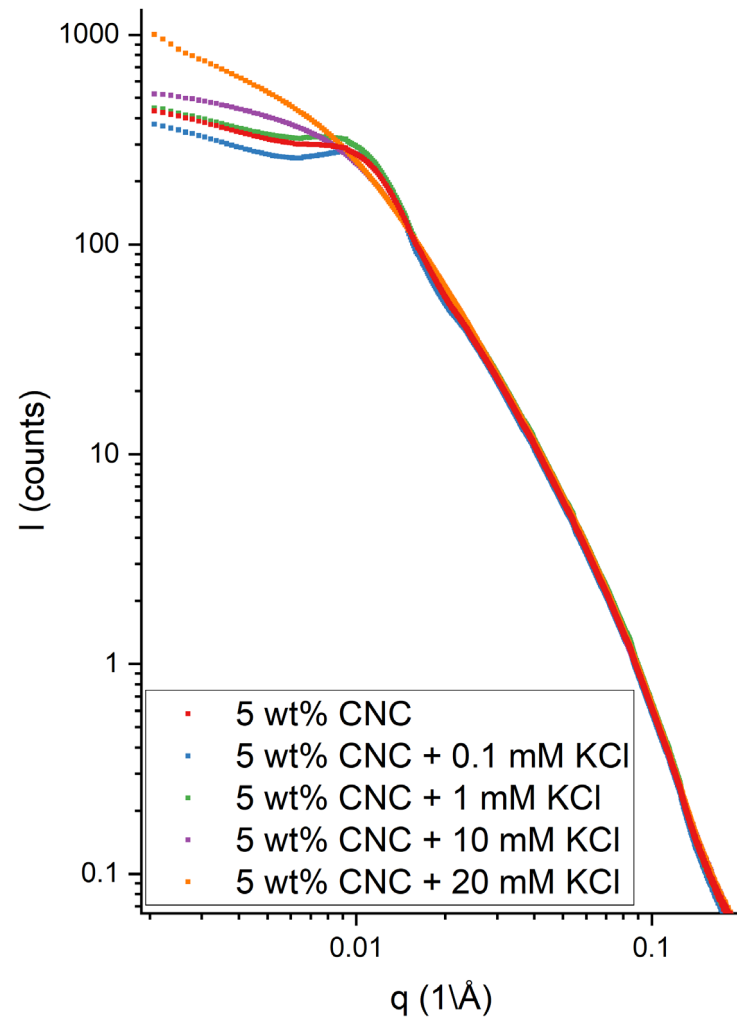


# Suspension rheology

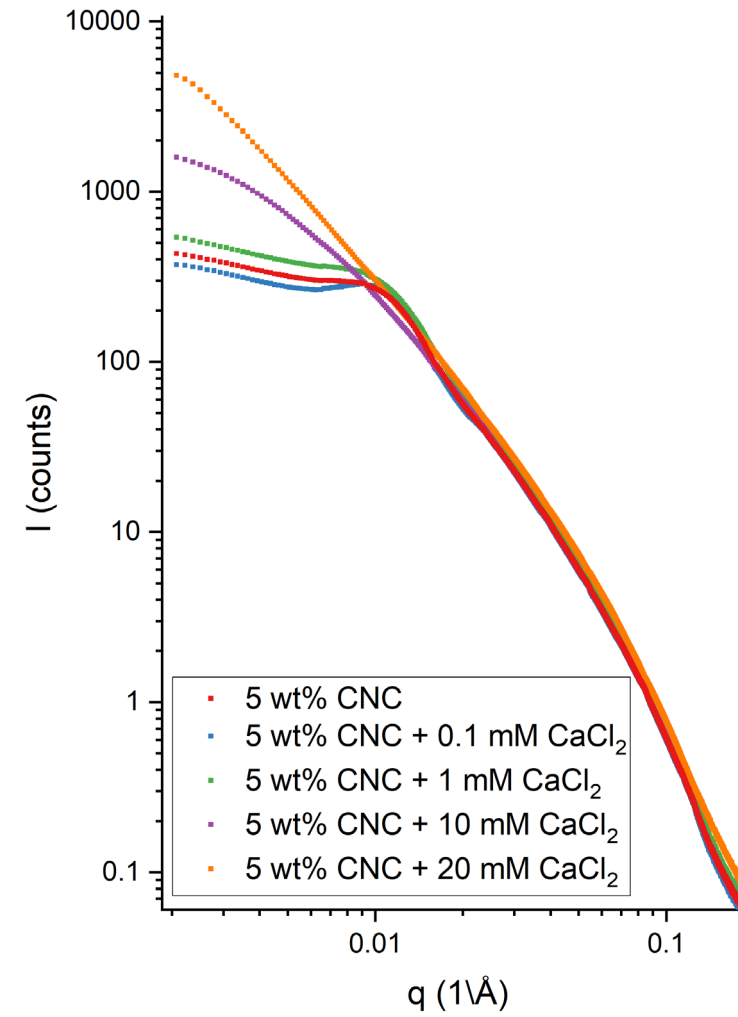
## CaCl<sub>2</sub> concentration



# SAXS data

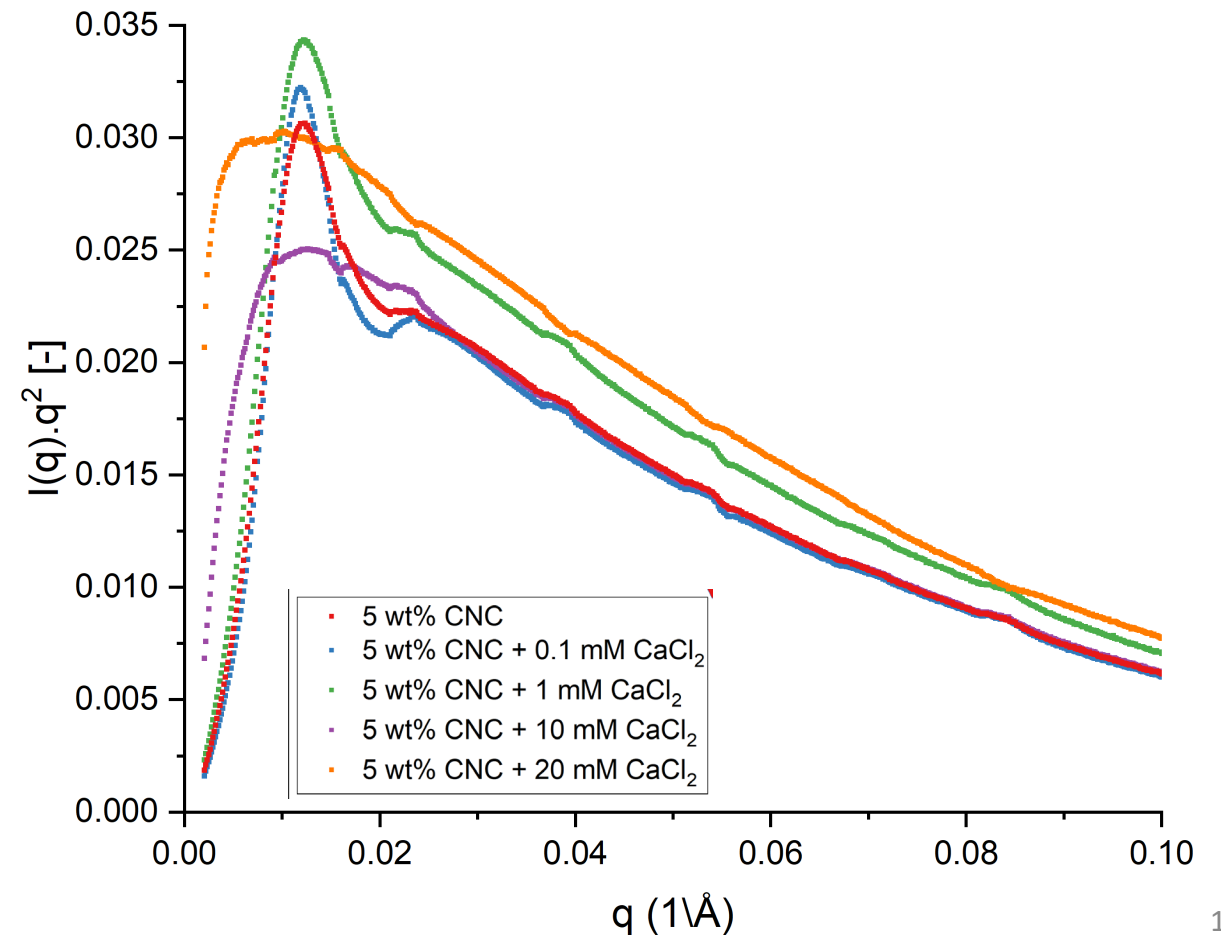
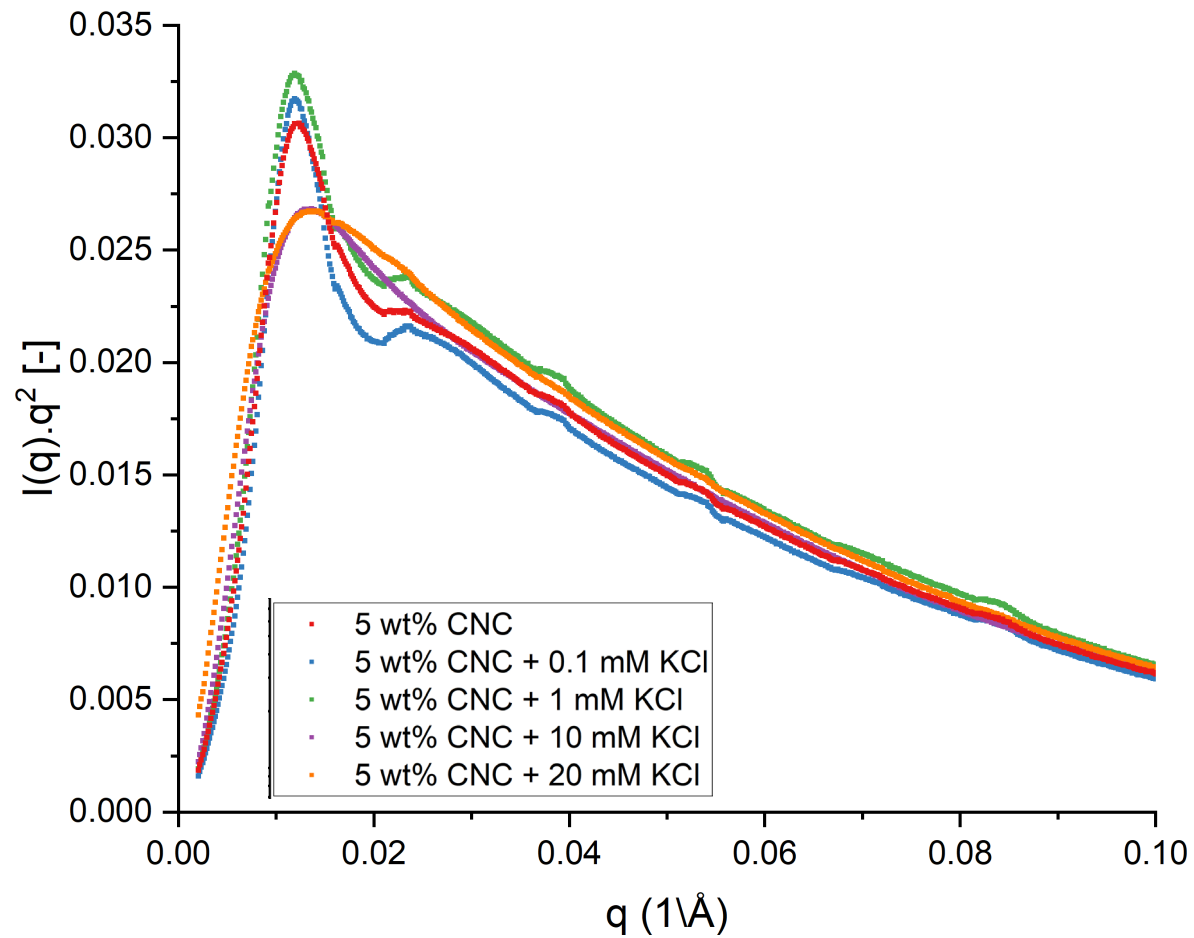


**KCl**



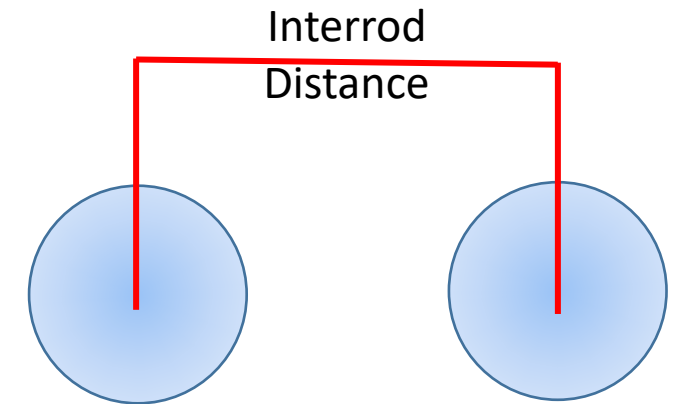
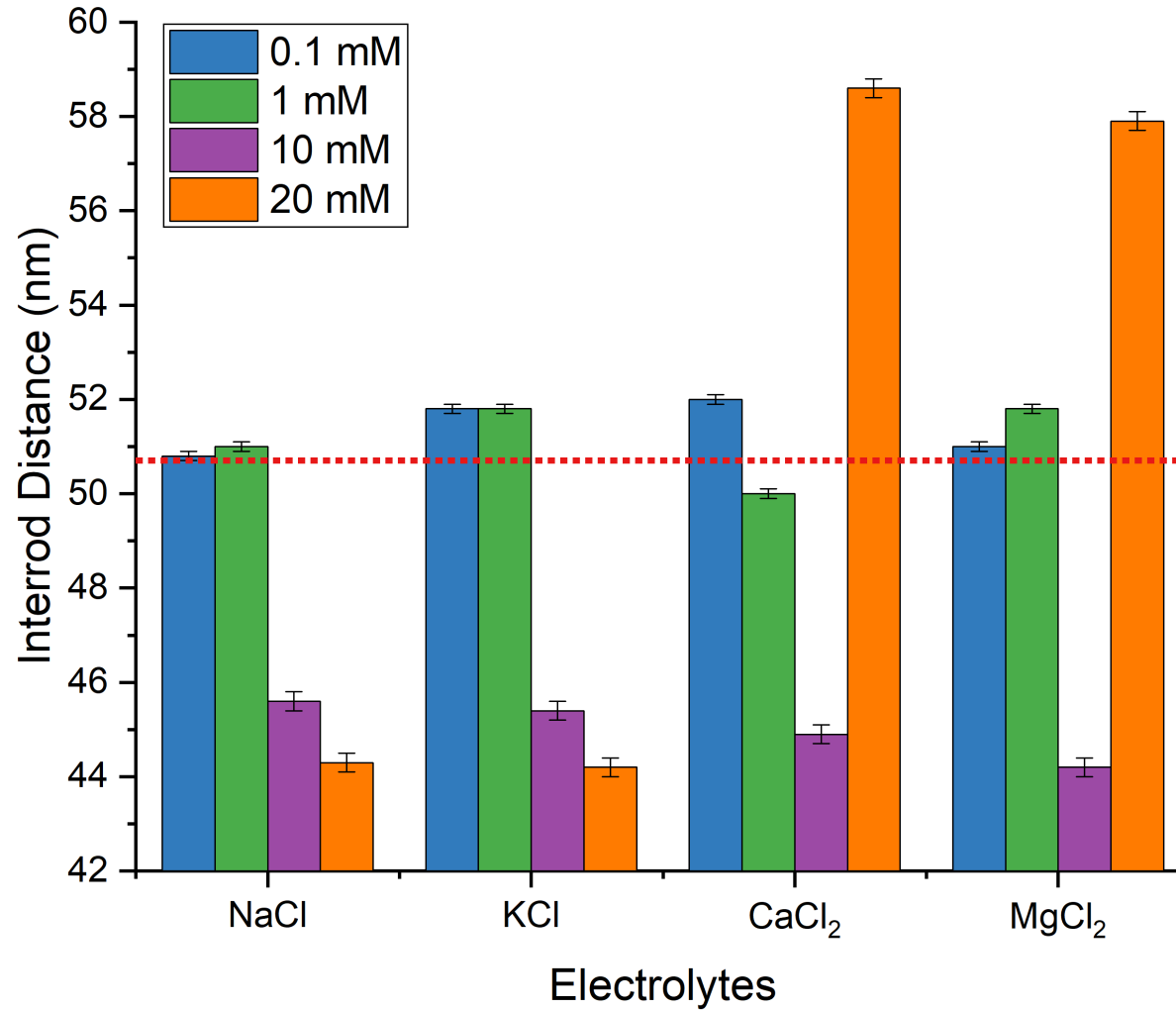
**CaCl<sub>2</sub>**

# Kratky Plots

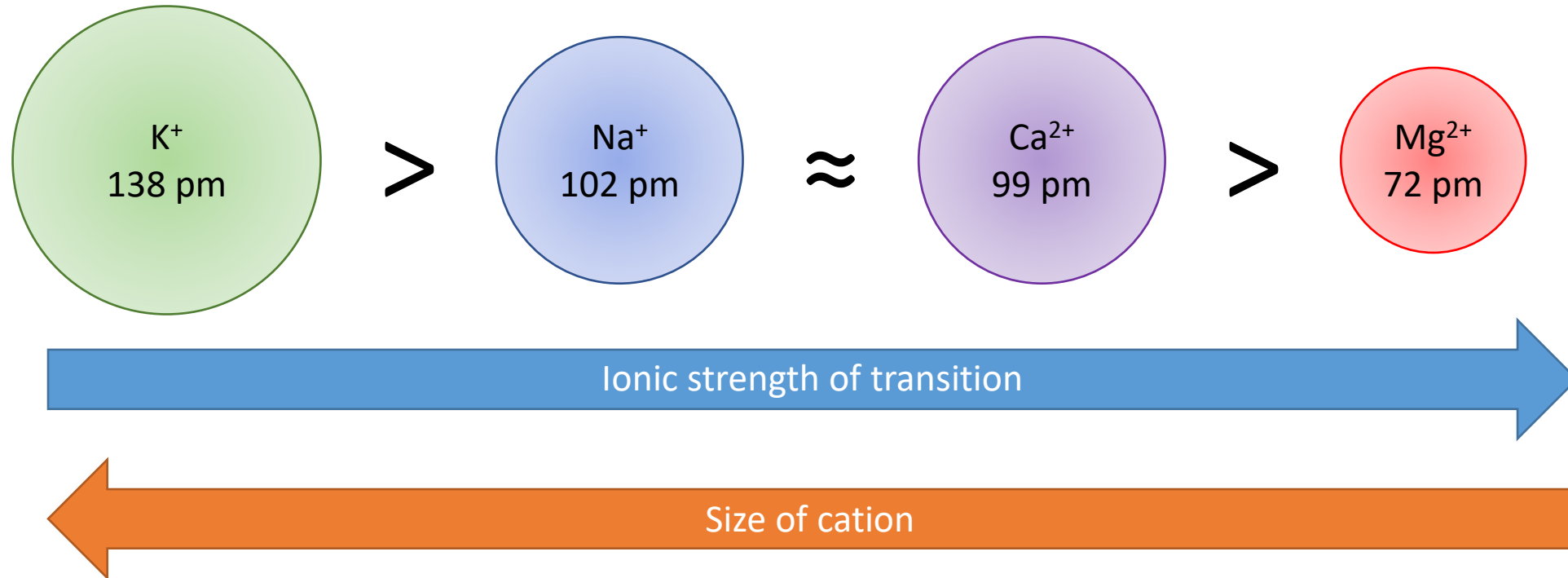


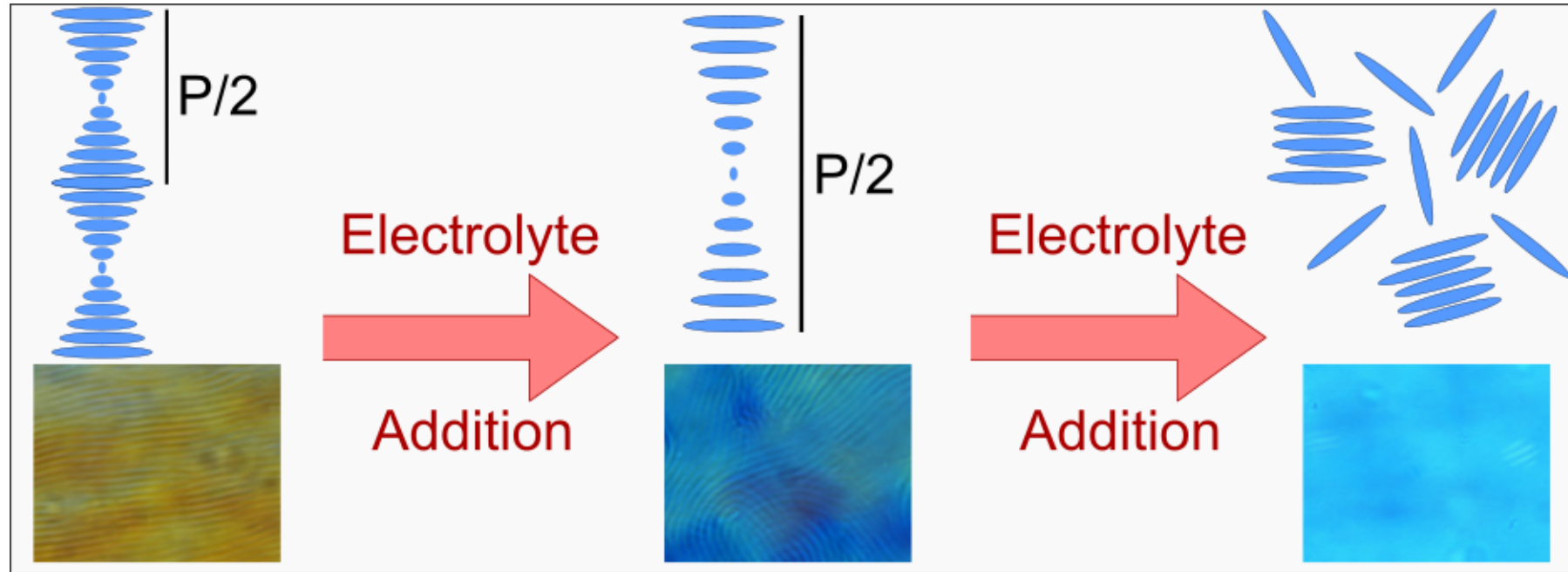


# Interrod distance



# Ion specificity





Change in chiral nematic structure

Ion size

# Acknowledgements



- Dr Vikram Singh Raghuwanshi (Monash University)
- Prof. Gil Garnier (Monash University)
- Assoc. Prof. Warren Batchelor (Monash University)
- Dr Nigel Kirby (Australian Synchrotron, ANSTO)



**Australian Government**  
**Australian Research Council**