COST FP 1205 Training School

Pretreatment and dissolution of cellulose

Cellulose Nanocrystals (CNC) Modification and CNC/Ionic Liquid Mixture Preparation

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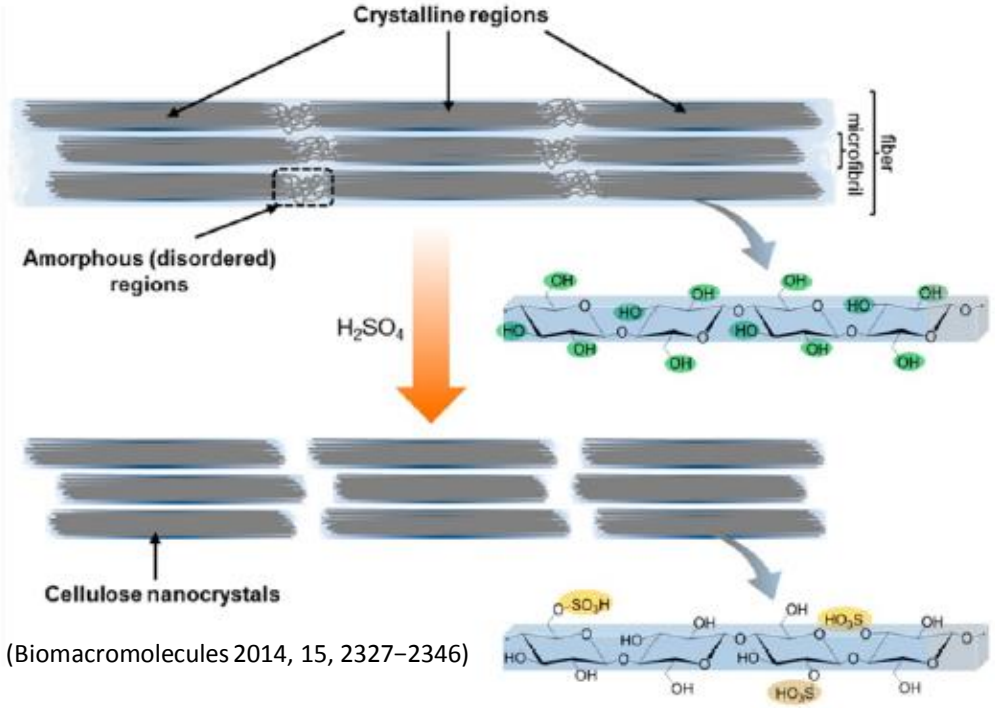
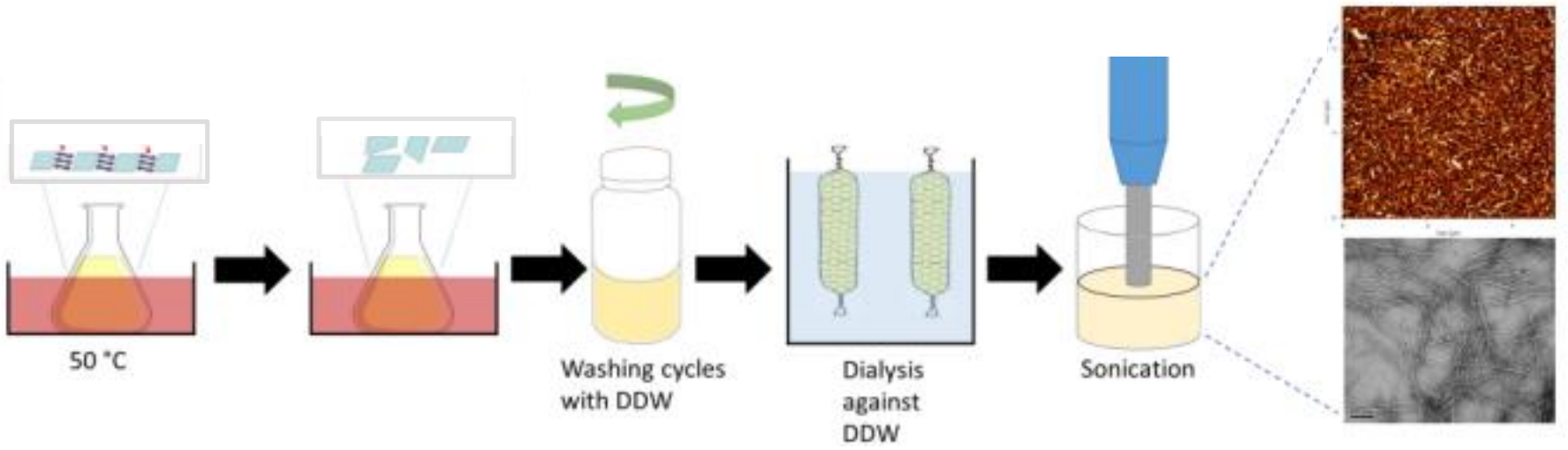
Cellulose nanocrystals



(Biomacromolecules 2014, 15, 2327−2346)

- **Cellulose nanocrystals (CNC) is an emerging renewable nanomaterial with high tensile strength (7500 MPa), high stiffness (Young's modules of 100-140 GPa), together with other intriguing electrical and optical properties.**
- **CNC is considered promising nanomatieral for composite reinforcement, coatings, light-weight foams and hydrogels.**

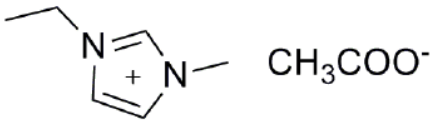
CNC preparation



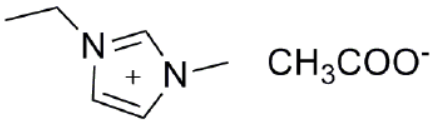
Cellulose nanocrystals are prepared by H_2SO_4 treatment of cellulose microfibrils, which causes the hydrolysis of the amorphous regions.

Ionic liquids (ILs)

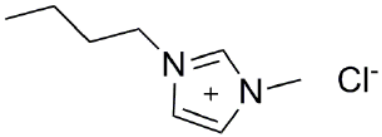
- Liquids composed of ions that are liquid around or below 100 ^{o}C
- Unique physicochemical properties
  such as negligible volatility, thermal stability, tunable structures, and so on
- Dissolution and processing of biomass



1-ethyl-3-methylimidazolium acetate
([EMIm]OAc)



1-butyl-3-methylimidazolium acetate
([BMIm]OAc)



1-butyl-3-methylimidazolium chloride
([BMIm]Cl)

In this section:

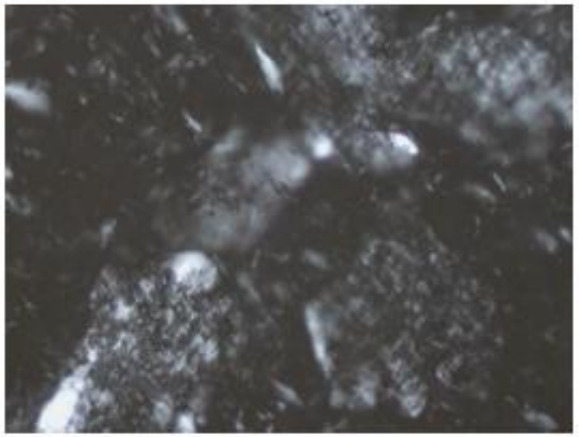
- Dissolution and solvent-exchanging methods were employed and compared to prepare CNC/IL mixture.

- The binding between reslin-cellulose binding domain (CBD) and CNC in IL environment was also tested using both methods.

PLM

CNC aqueous suspension

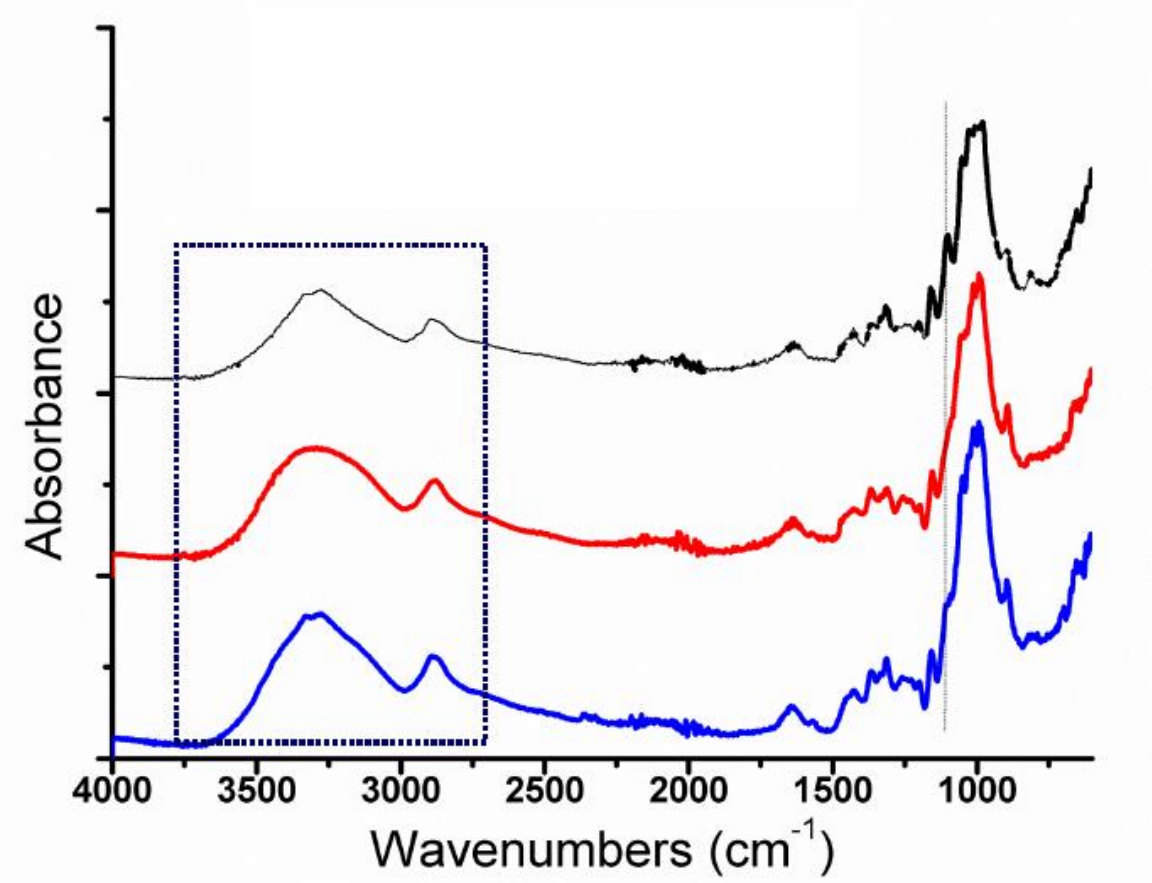
Dissolution CNC-IL mixture



Solvent-exchange CNC-IL mixture

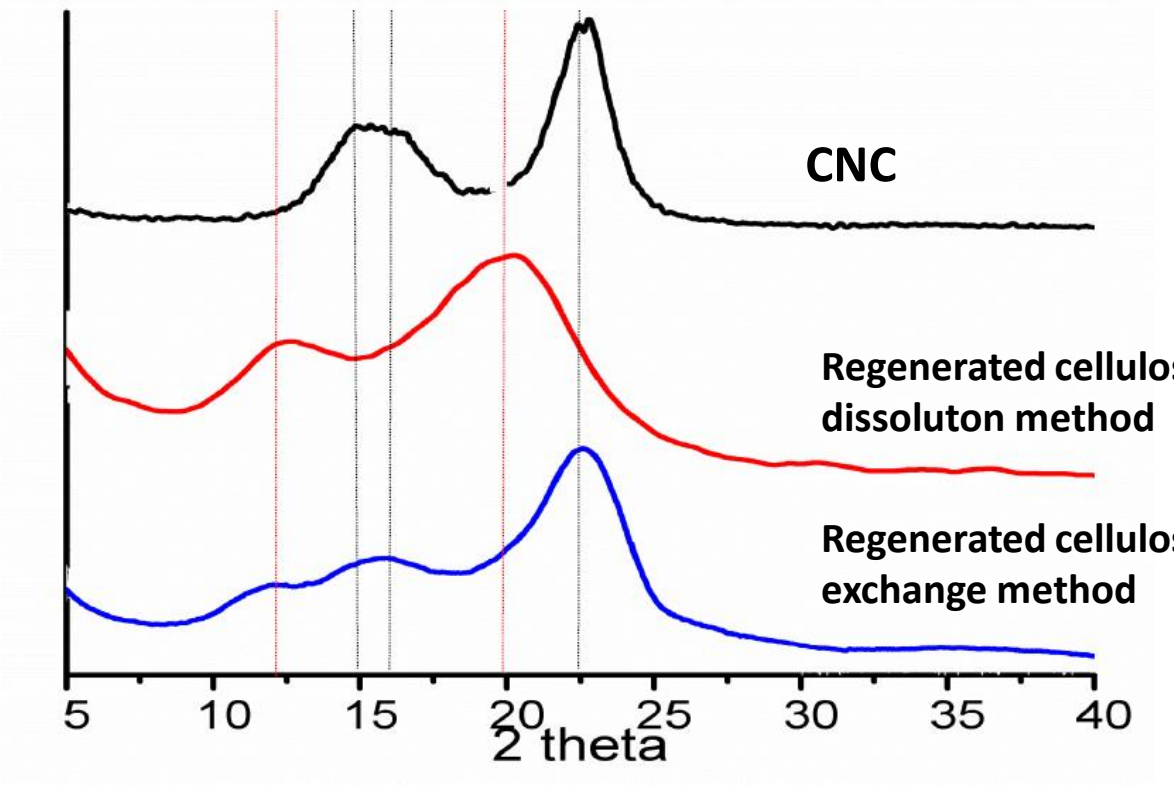
Birefringence were observed for CNC aqueous suspension and the CNC-IL mixture prepared by the solvent-exchange method.

ATR-IR



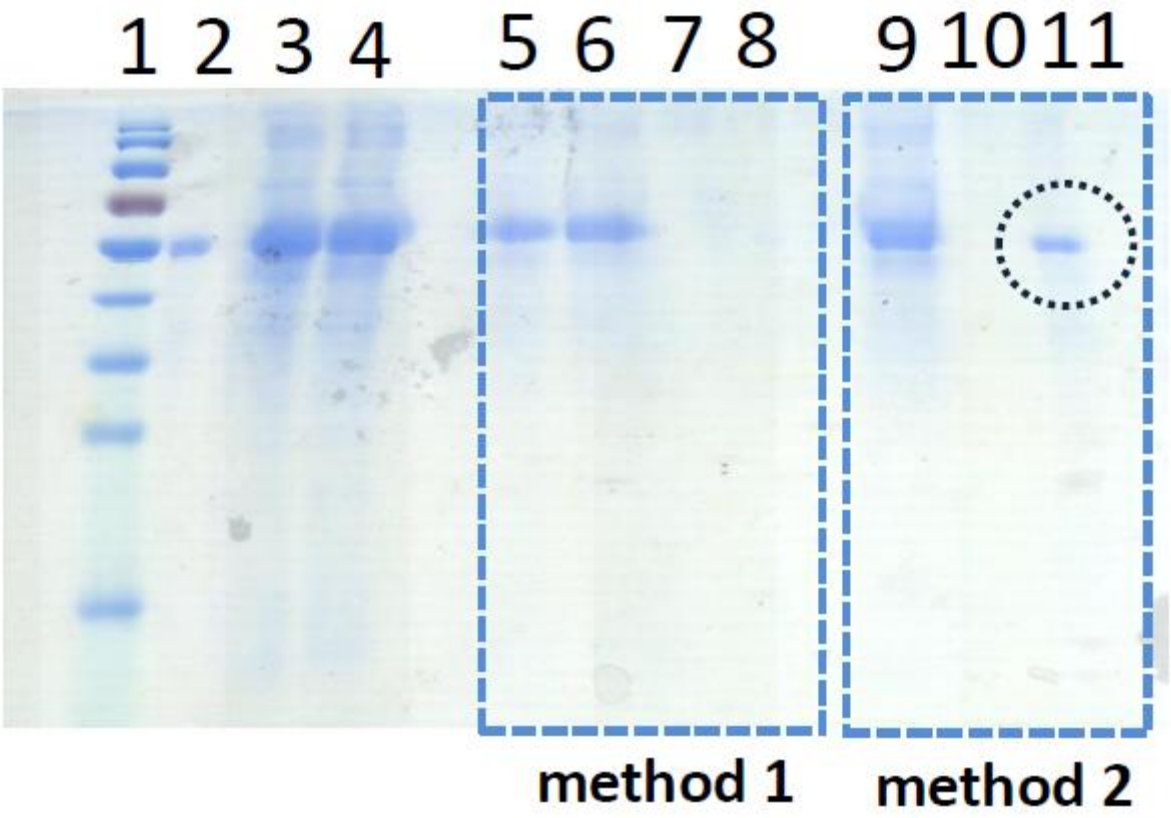
ATR-IR figures of **CNC film (black)**, regenerated cellulose film from **CNC dissolution in IL (red)** and regenerated cellulose film from **CNC solvent-exchanged from water to IL (blue)**.

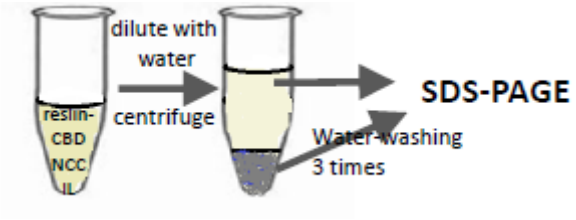
XRD



CNC – cellulose I
Regenerated cellulose from dissolution – cellulose II
Regenerated cellulose from solvent-exchange – mainly cellulose I

Reslin-CBD-CNC/[EMIm]OAc





1. ladder
2. Reslin-CBD aqueous solution

3~4 reslin-CBD dissolved in IL

5~8 dried reslin-CBD-NCC dissolved in IL

5. Diluted with 2.5 times water, without centrifugation
6. Diluted with 2.5 times water, centrifugation, sup.
7. The 3rd time washing the pellet with water
8. The pellet

9~11 reslin-CBD-NCC aqueous solution solvent exchange IL

9. Diluted with 2.5 times water, centrifugation, sup.
10. The 3rd time washing the pellet with water
11. The pellet

Conclusion

- The CNC/IL mixture prepared by solvent-exchange mainly keeps the cellulose I structure.

- The crystal structure of CNC was changed from cellulose I to cellulose II and the binding of reslin-CBD with CNC was destroyed by using the direct dissolution method.

Many thanks
for your attention!

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