Dry cellulose powder as a precursor to high quality nanocellulose

Presented by

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Esterification and hydrolysis of cellulose using oxalic acid dihydrate in a solvent-free reaction suitable for preparation of surface-functionalised cellulose nanocrystals with high yield†

D. Li, J. Henschen and M. Ek*

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ELSEVIER

Preparation of cellulose nanomaterials via cellulose oxalates

Jonatan Henschen*, Dongfang Li, Monica Ek*

KTH VETENSKAP OCH KONST

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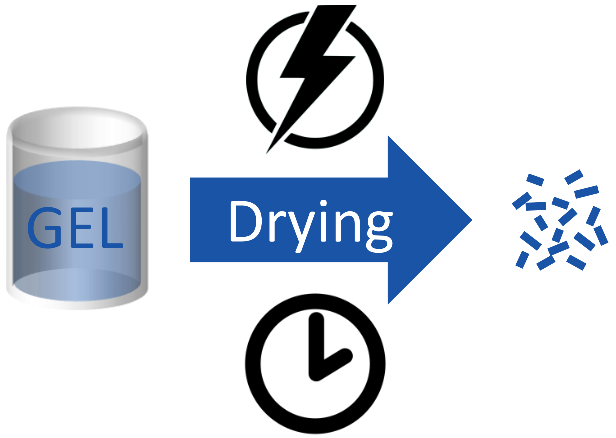
Making Advanced Cellulose
for a Biobased Future

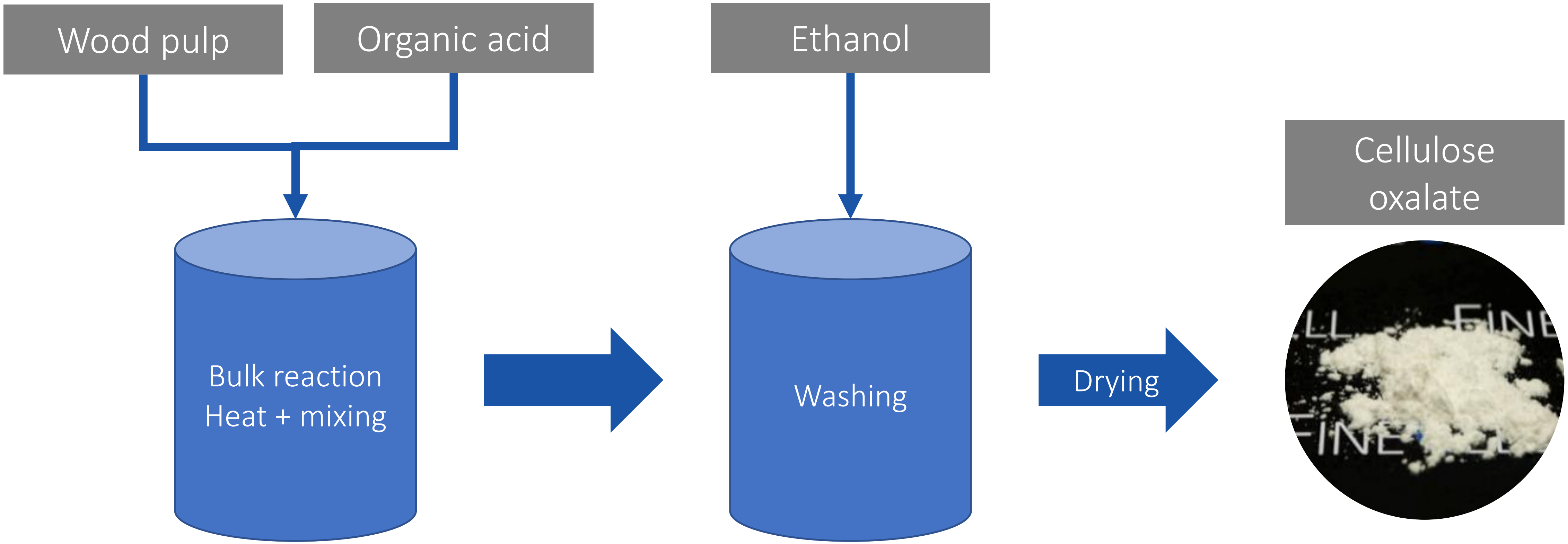
Current production processes for nanocellulose

- Mechanical
- Enzymatic pretreatment
- Carboxymethylation pretreatment
- TEMPO pretreatment
- Sulphuric acid hydrolysis

CHALLENGES TODAY

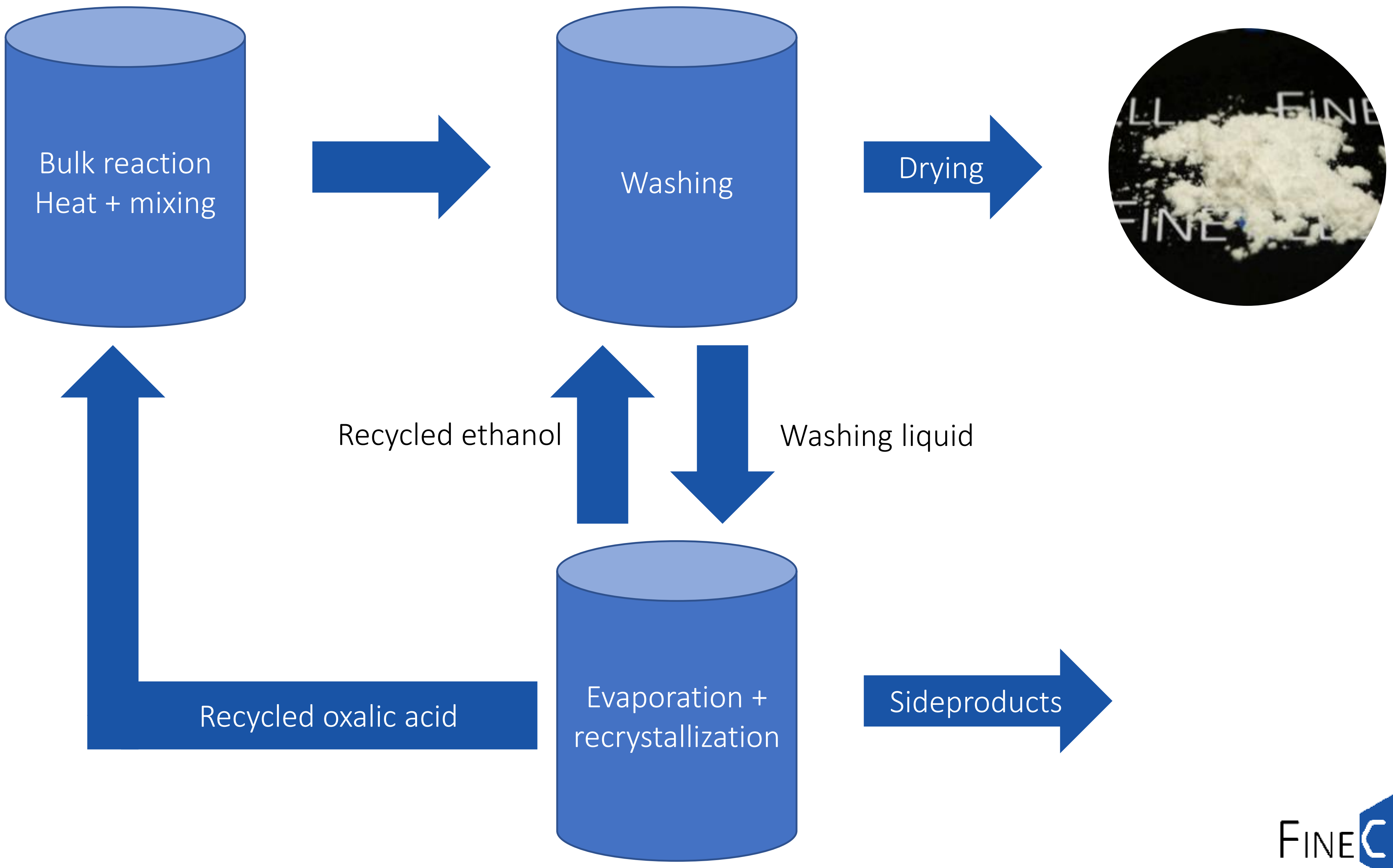
Use	Performance	Process
	Poor compatibility with molten plastic Poor mechanical properties	Difficult to scale, e.g. chemical recovery

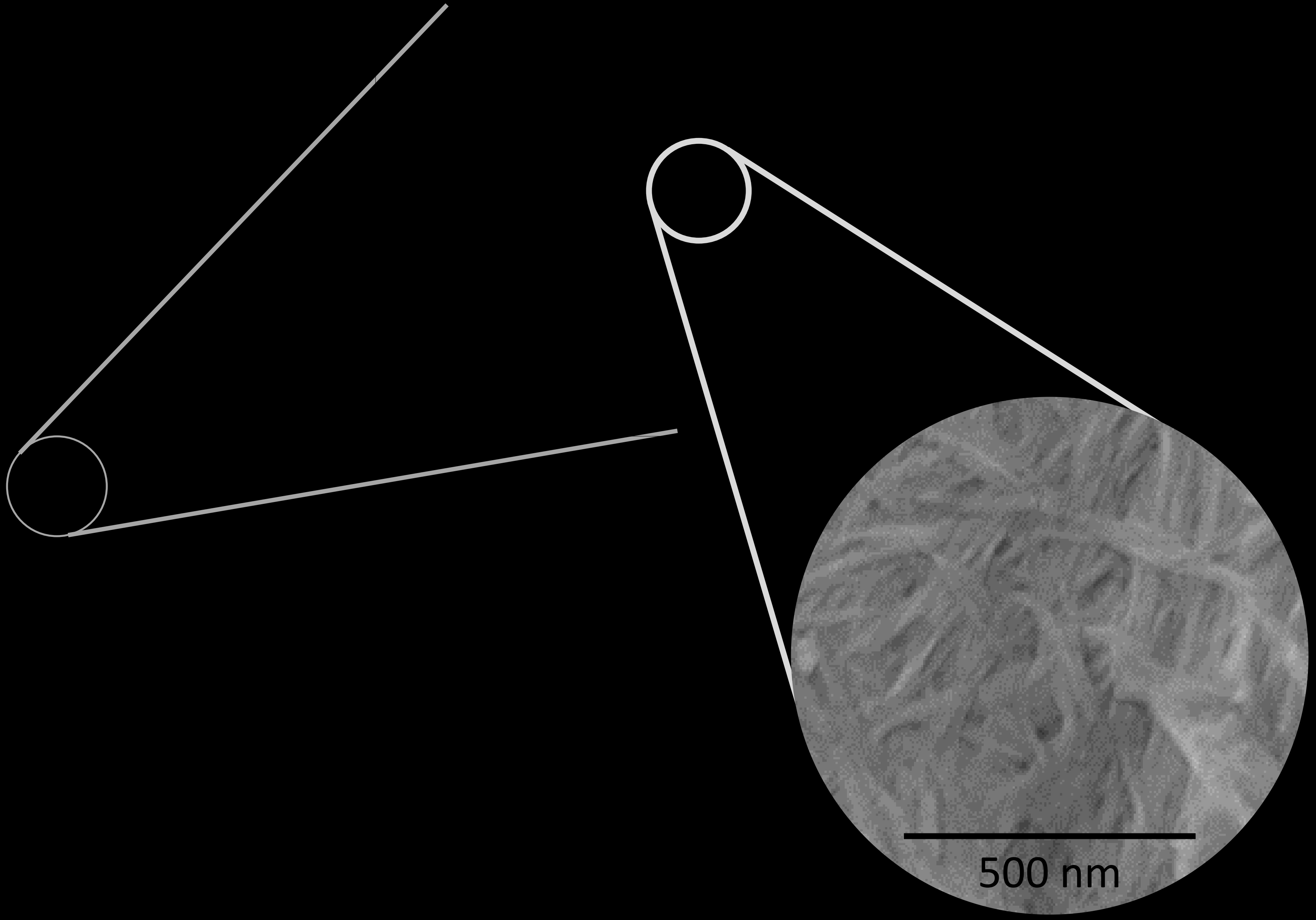
PREPARING CELLULOSE OXALATE



SUSTAINABLE • EFFICIENT PRODUCTION • EASY PRODUCT INTEGRATION

FINECELL


Bulk reaction
Heat + mixing
Washing
Drying
Recycled ethanol
Washing liquid
Recycled oxalic acid
Evaporation +
recrystallization
Sideproducts

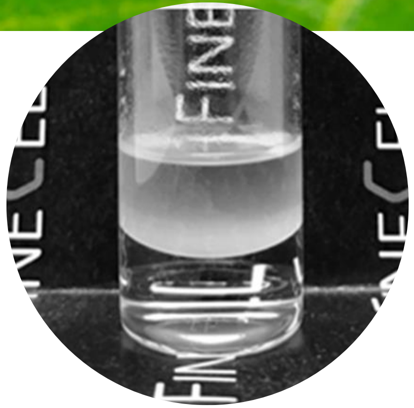

500 nm

Cellulose oxalate

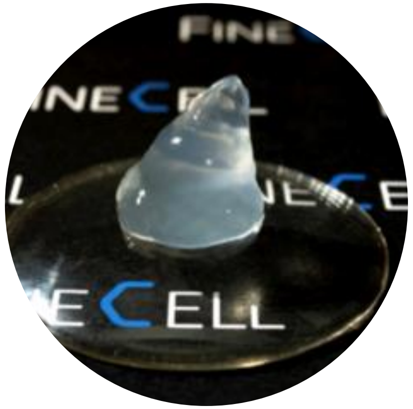
Chemical modification, e.g. hydrophobization

Fibrillation to nanocellulose

Use in products



Hydrophobic cellulose



Nanocellulose hydrogel

Reinforced biocomposites

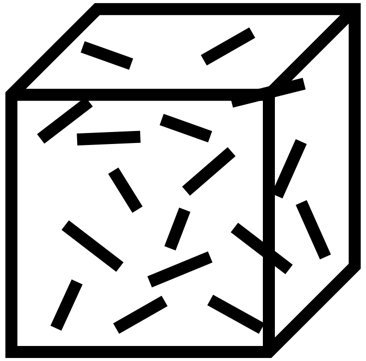
Ultrasonication

150 – 220 nm long
16 – 20 nm wide

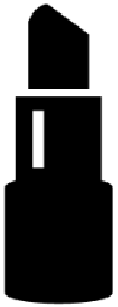
Microfluidization

340 – 370 nm long
3.2 – 4.3 nm wide

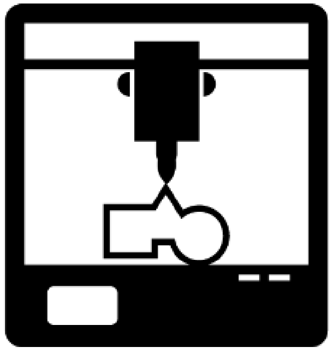
Focus markets



PLASTIC & COMPOSITE



COSMETICS



3D BIOPRINTING

PLASTIC & COMPOSITES – REINFORCING BIO-PBS

BIOPBS™

Strong
Lightweight

Recyclable
Easily biodegradable

BIOPLASTIC CAPABLE TO REPLACE FOSSIL PLASTICS

FINECELL

PLASTIC & COMPOSITES – REINFORCING BIO-PBS

BioPBS, an easily biodegradable material is too soft (low flexural modulus) for many applications. Cellulose oxalate stiffens the material to make it comparable with polypropylene. There is great potential for further improvements!

Material	Tensile modulus GPa	Elongation @ break %	Flexural strength MPa	Flexural modulus GPa	Density g/cm3
BioPBS	0.7	170	40	0.63	1.26
BioPBS 20% FC	1	3.3	42.4	1.0	1.31
BioPBS 15% FC + 15% pulp fibers	1.5	1.5	43.7	1.6	1.33

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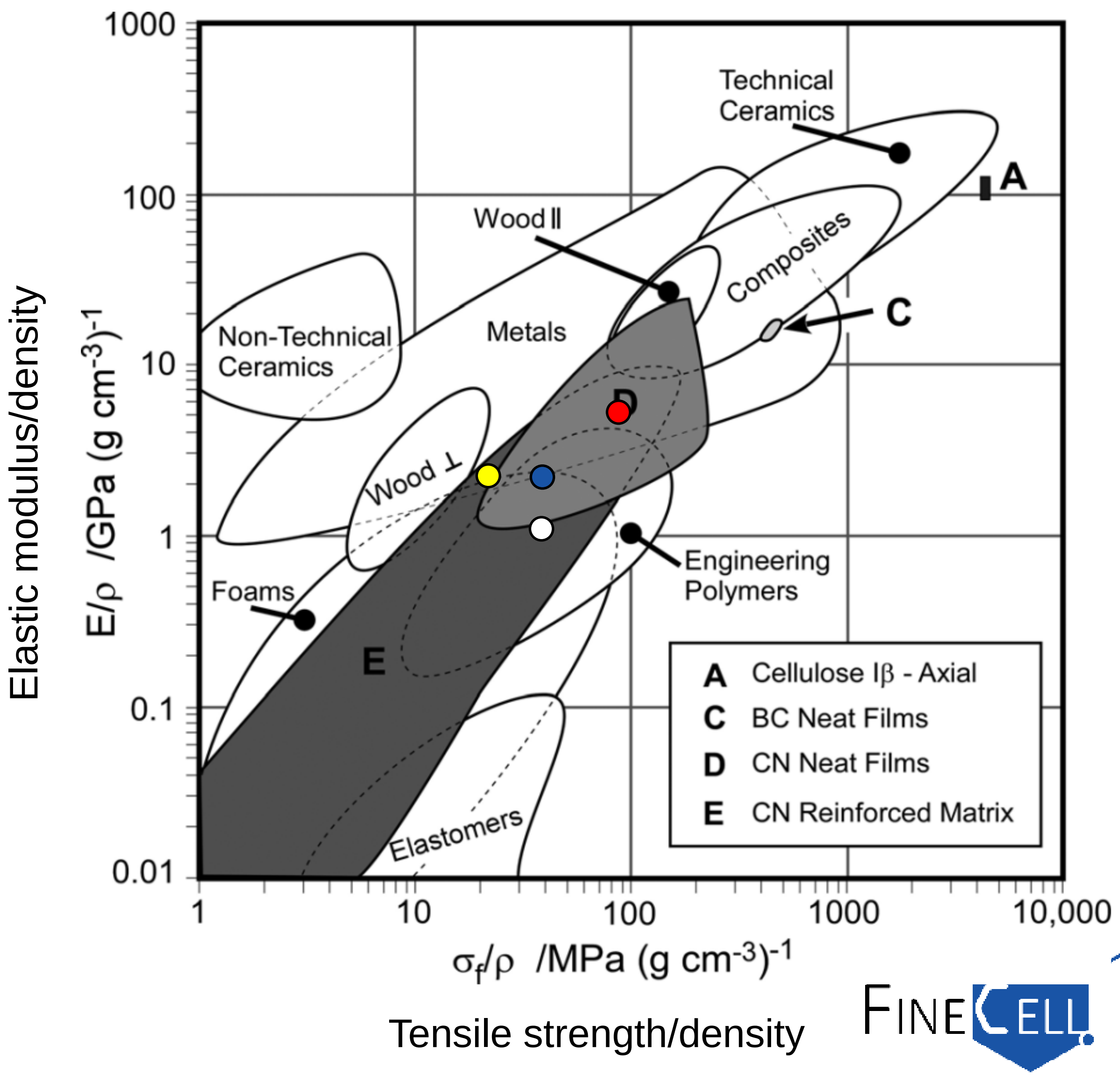
PLASTIC & COMPOSITES – REINFORCING PP

○ Neat PP

● 30 wt% filler content of talc (fine grade)

● 30 wt% filler content of our cellulose microfiber (early lab results)

● 30 wt% filler content (Where we'll be)



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LIGHT-WEIGHTING potential for PP

Enabled by increasing specific modulus and/or specific strength as a result of cellulose's reinforcement, which means less materials (in terms of weight) are needed to bear the same loads.

Reinforcement (PP as matrix)	Filler content	Lightweighting potential* (as comparing with neat PP)
1. Cellulose oxalate (early lab trials)	30 wt%	-45%
2. Talc (fine grade)	30 wt%	-31%
	40 wt%	-29%
3. Potential of cellulose oxalate	30 wt%	-70%

*Calculation model: a cylindrical material with a fixed length of 5 cm, for standing a load of 500 N. The load is applied along the length of the material.

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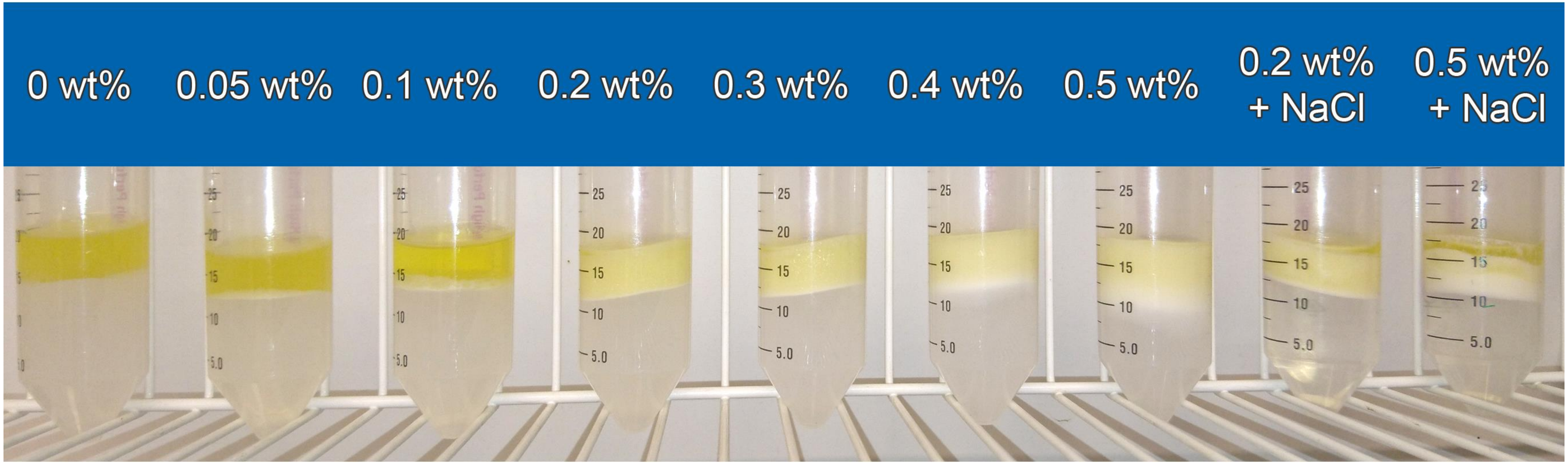
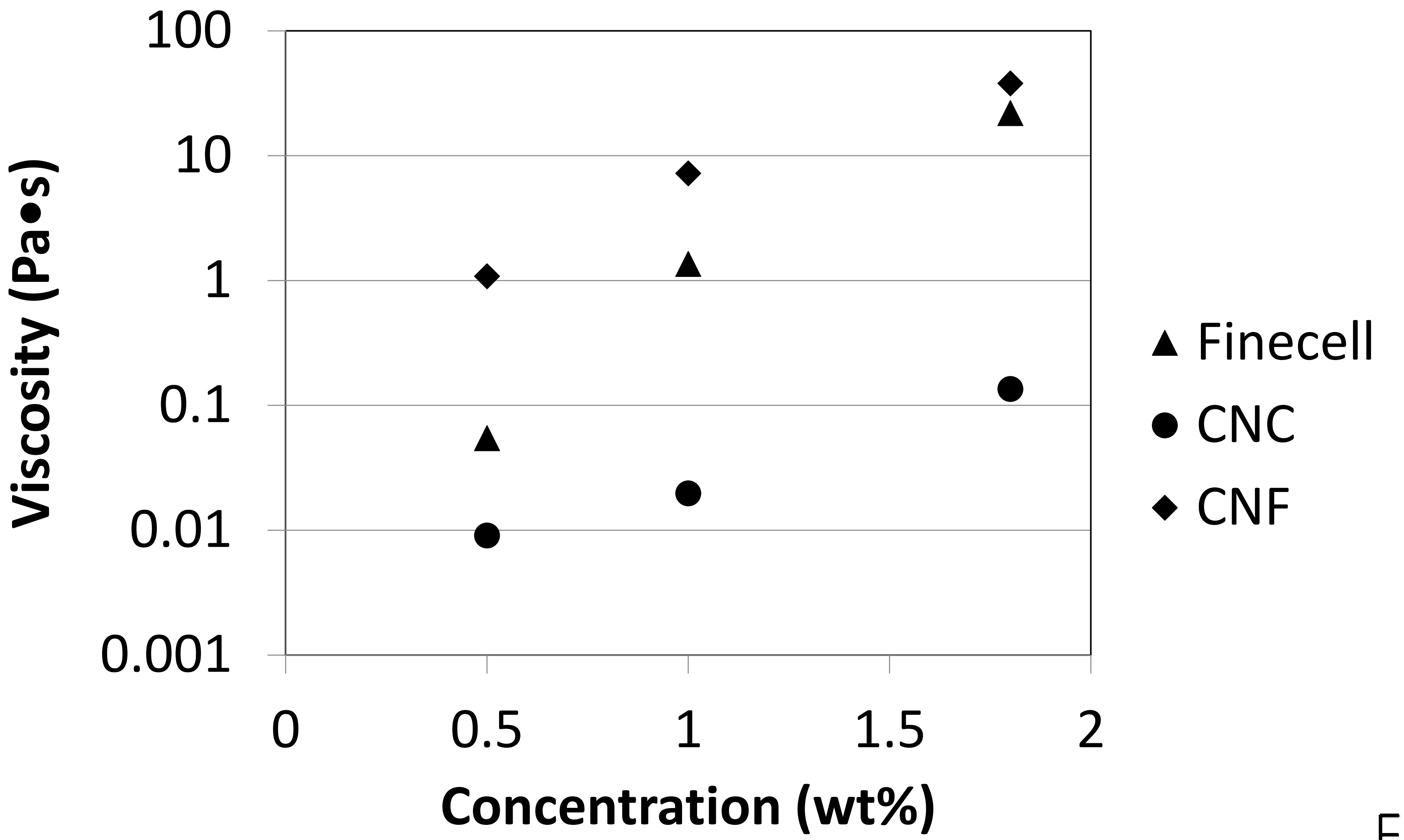
Stabilizing o/w emulssions



Steady-state shear viscosity at 1 s^{-1}



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NANOCELLULOSE FROM CELLULOSE OXALATE

DRY PRODUCT

Easy to use in many applications

SCALABLE PRODUCTION PROCESS

CARBOXYL FUNCTIONALIZED SURFACE

Enabling easy modifications to become compatible with different plastic matrices

Sounds interesting? Contact
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