Lignocellulosic Bioplastic as a Promising Active Food Packaging

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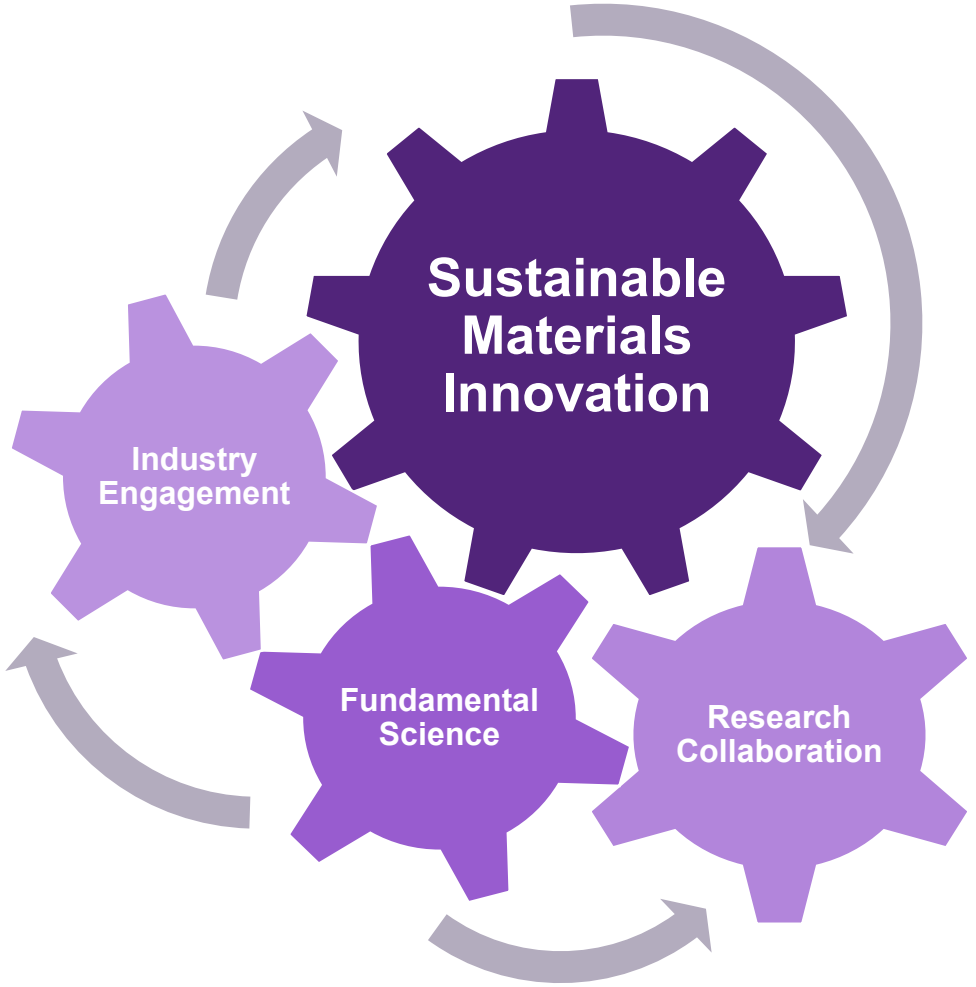
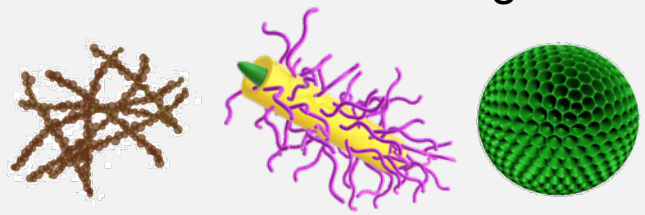
Bio-inspired Materials Group



Research interest

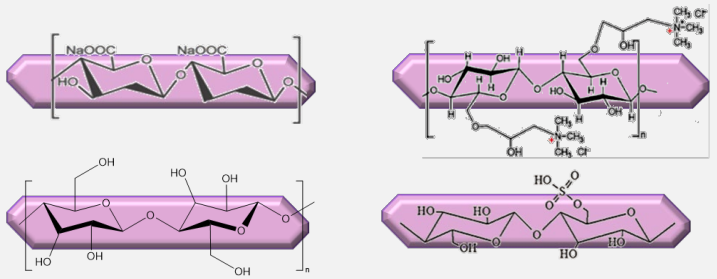
Nano-engineered materials

- Guided formation of nanoparticles
- Polymer brushes
- Antimicrobial materials
- Anti-corrosion coatings



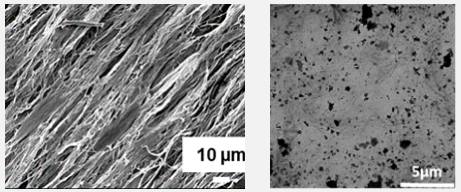
Nanocomposites

- Reinforcing polymers
- Reinforcing paper
- Carbon



Ag waste value-added products

- Biodegradable polymer
- Sorbent



Project

Energy storage	Packaging	Biocomposites for EV	Coating	Air filter	Medical textiles

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Packaging waste

300M tons of plastic/ year

36% packaging

85% single-use packaging

98% made from fossil fuels

10% recycled

$80-120B economic loss/year

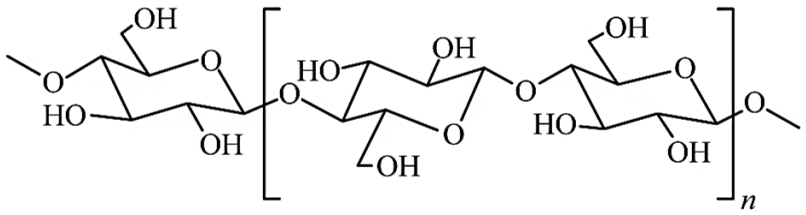
400 M tons of waste/ year

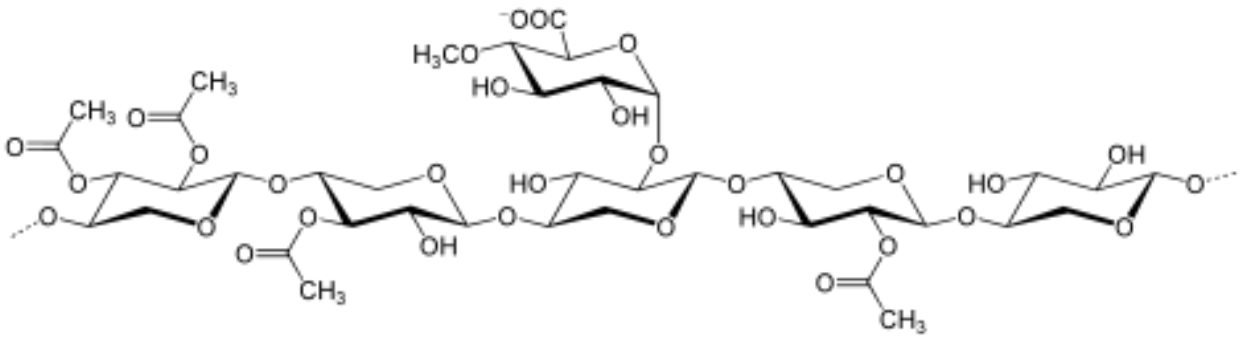
415M tons of paper & cardboard/ 2018

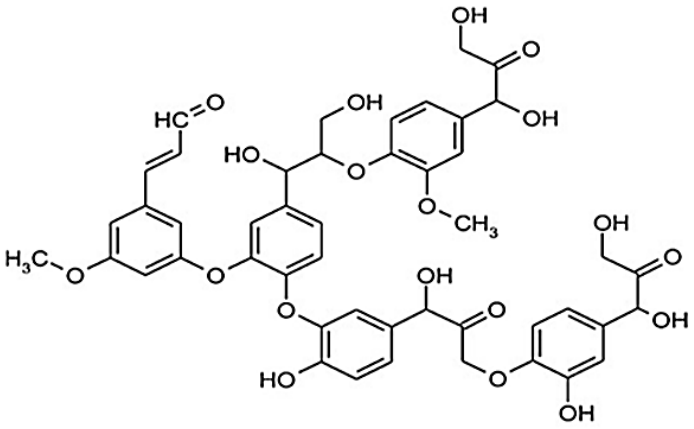
40% ends to landfill

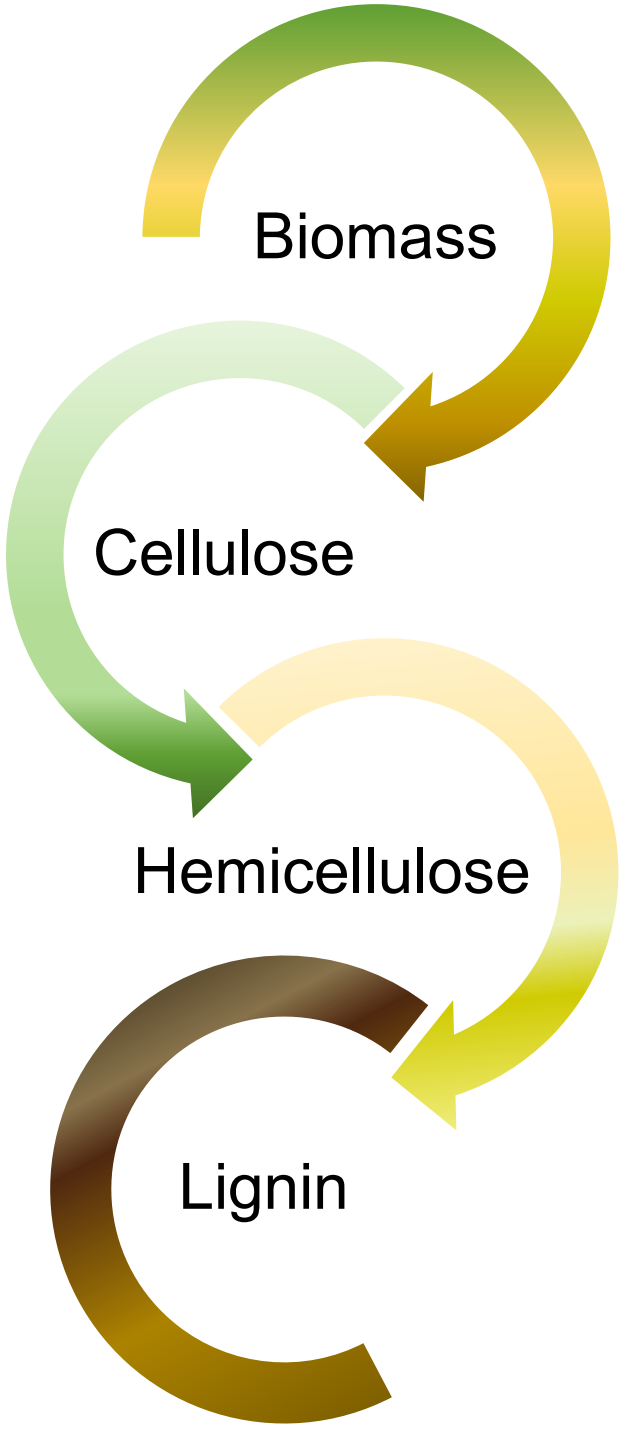
15% recycled

Biomass-based packaging









Challenges of lignocellulosic based packaging

High water and chemical for pulping

Hydrophobic coating/finish

Supply chain disruption

Water retention

Compatibility

Multi-step processing

Consistent quality

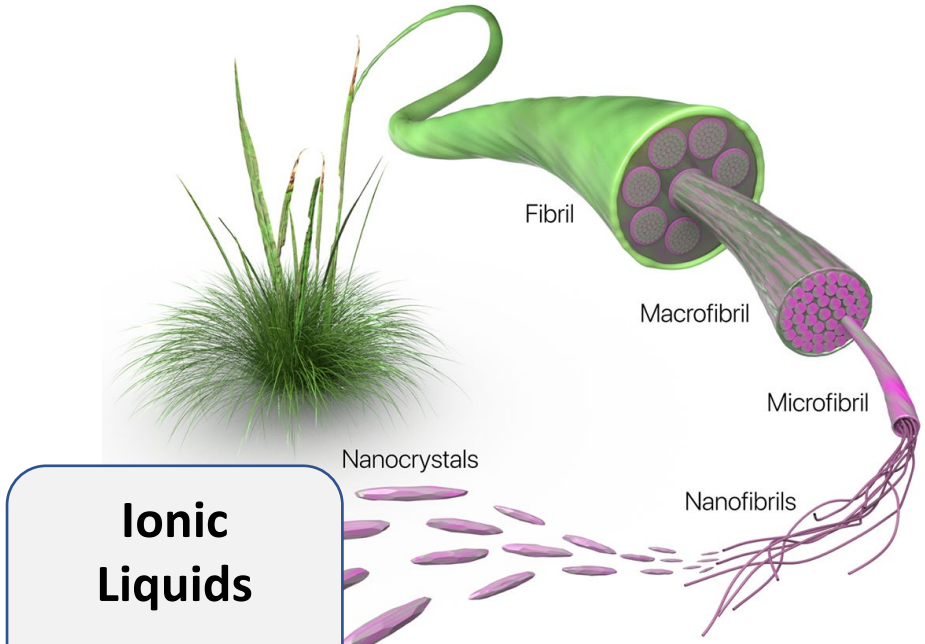
Durability

Tooling and equipment

Market acceptance

Lignocellulosic biomass treatment

Green Chemistry: “Safer Solvents and Auxiliaries”



Ionic Liquids

Acid treatment

- Dissolution of lignin
- Increase cellulose content and surface area

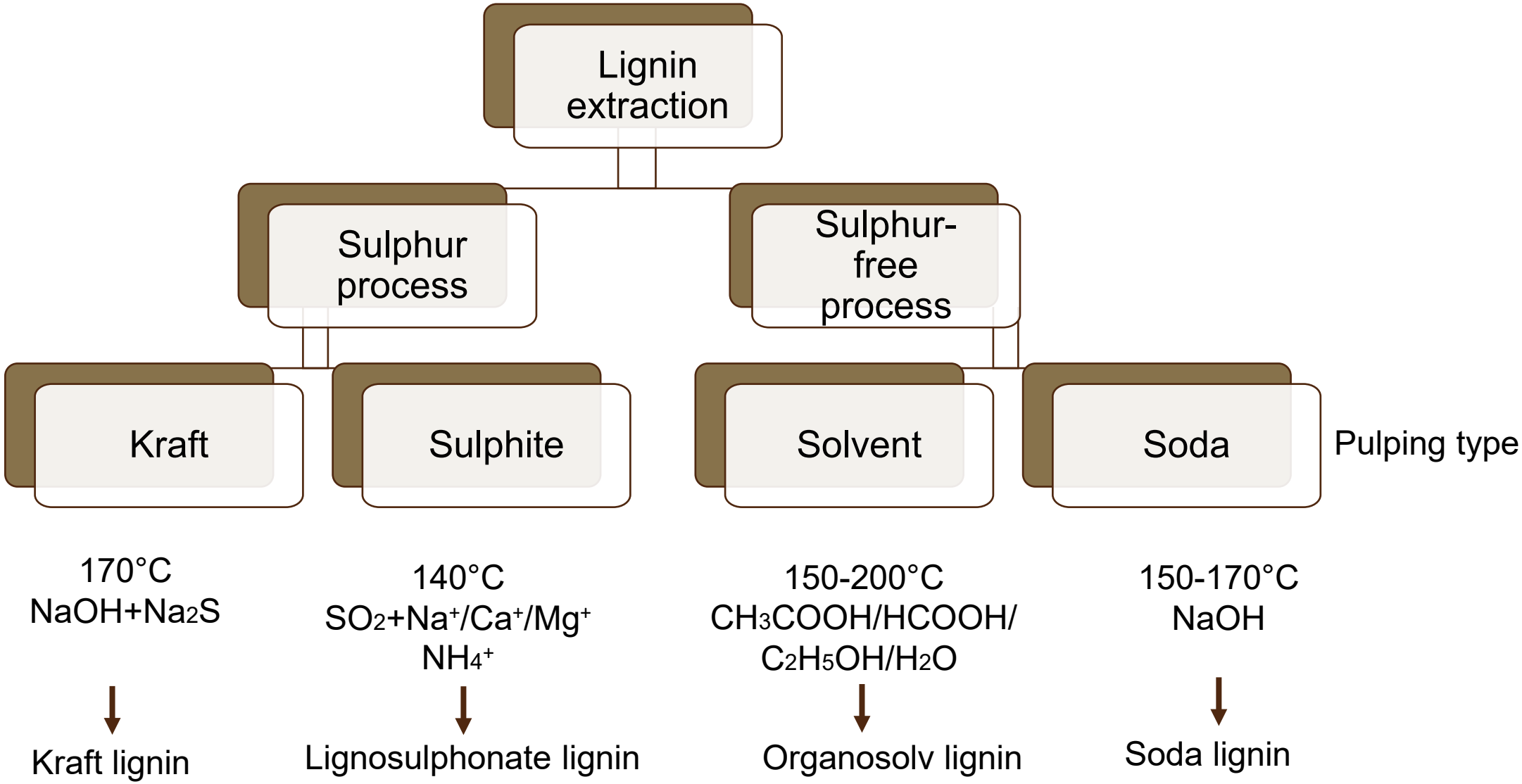
Alkali treatment

- Break the bonding between lignin and carbohydrate
- Increase the inner surface area
- Easy cellulose accessibility

Deep eutectic solvents treatment

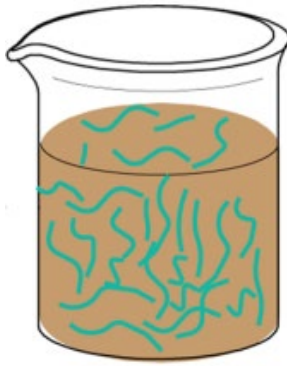
- Larger affinity toward lignin dissolution compared to cellulose
- Effective removal of hemicellulose
- Swelling and deconstruction of cellulose

Lignin processing

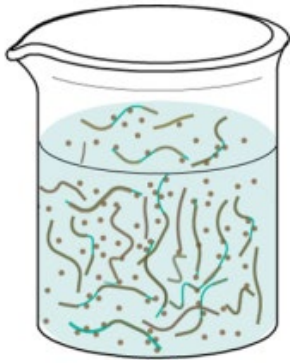


Sugarcane trash treatment with DES

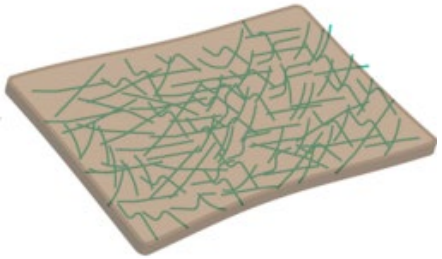
Acidic DES



Filtration



Dry

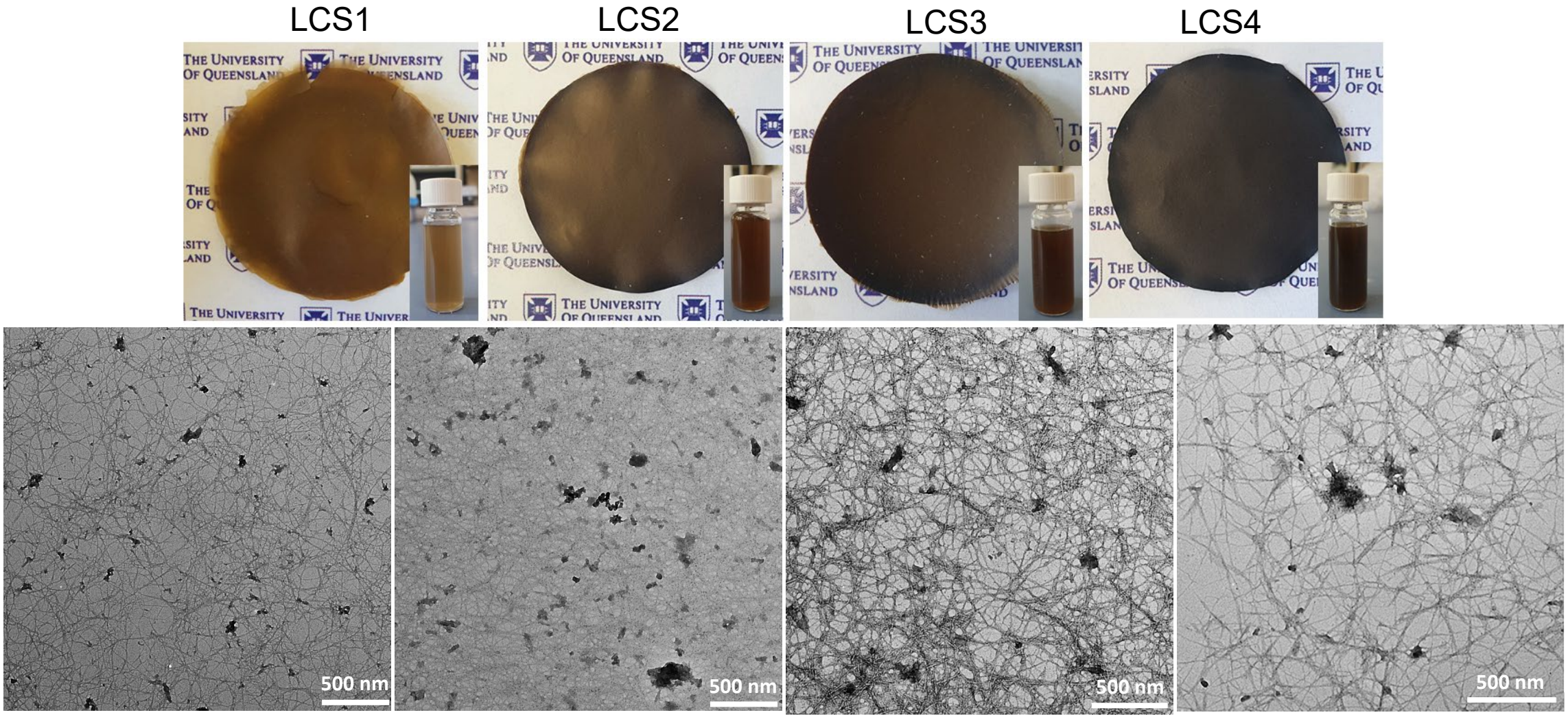


Lignin/hemicellulose dissolution
Destruction and fibrillation of cellulose

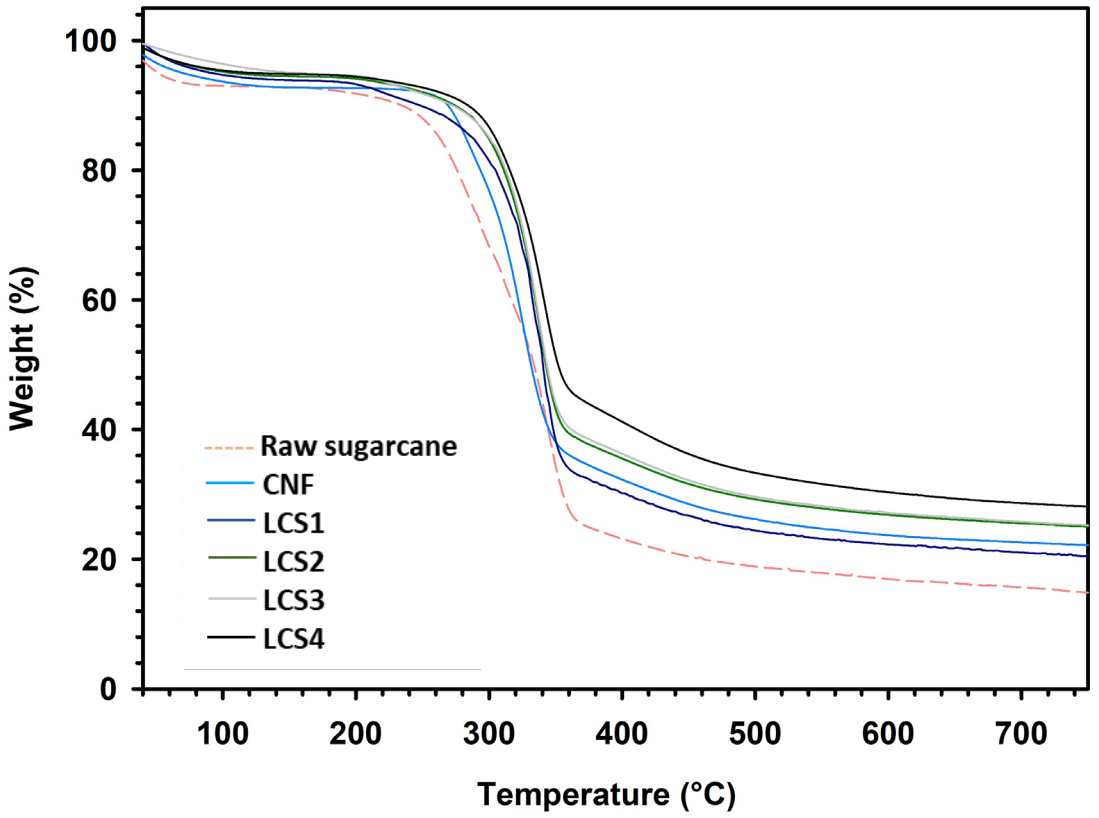
Lignin and cellulose nanofiber dispersion

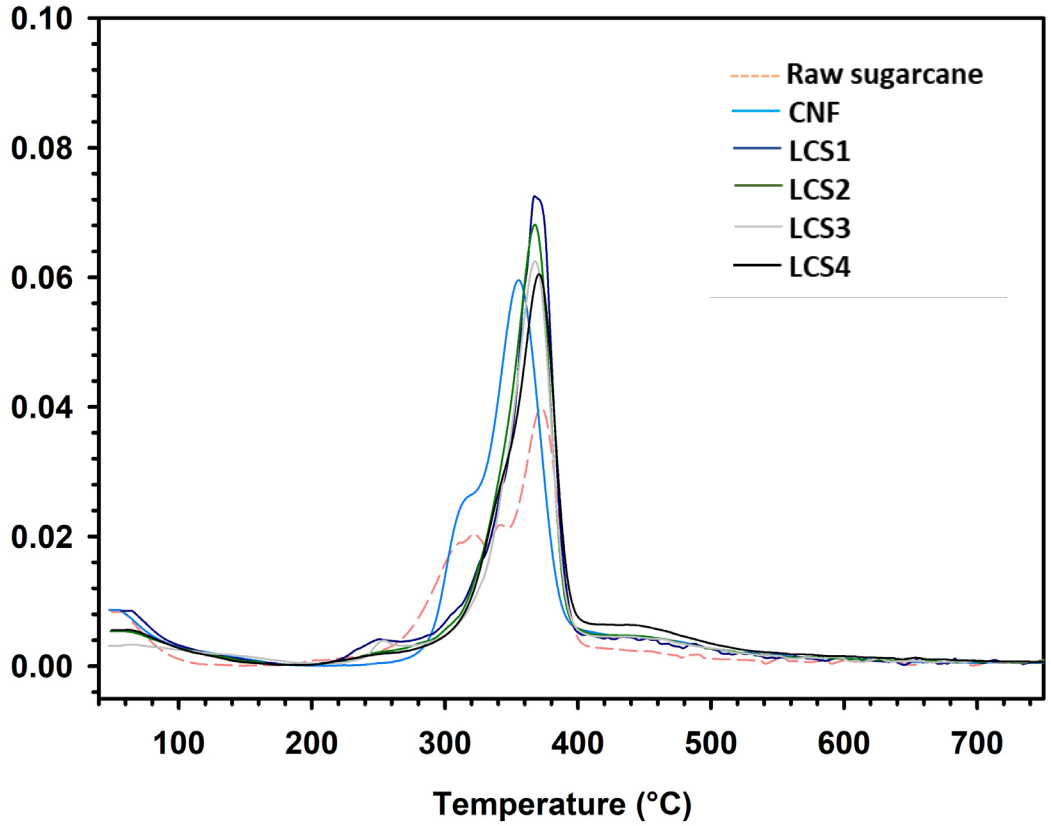
Lignocellulosic sheet

Morphology



Characterisation





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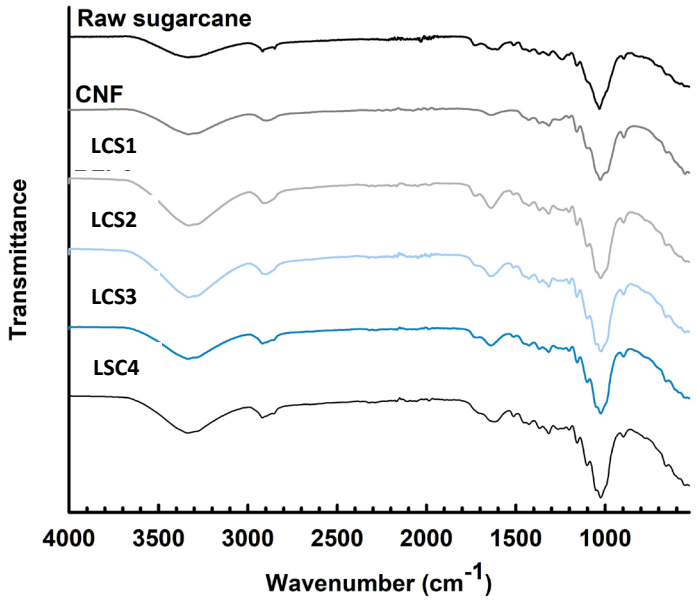
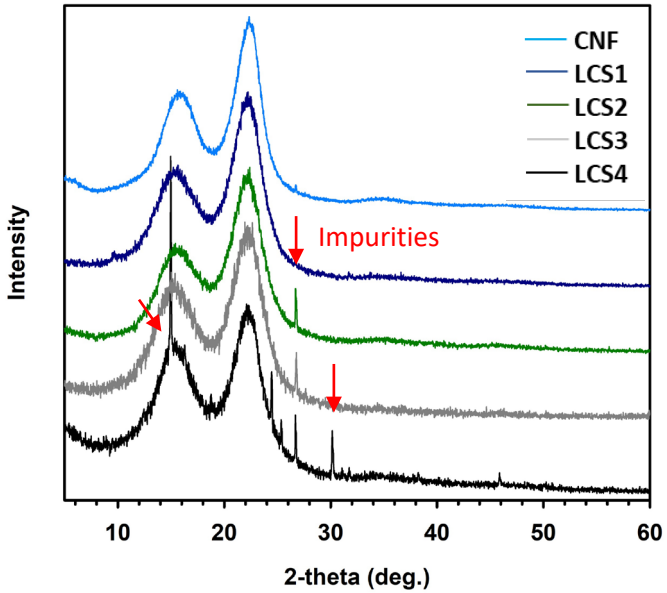
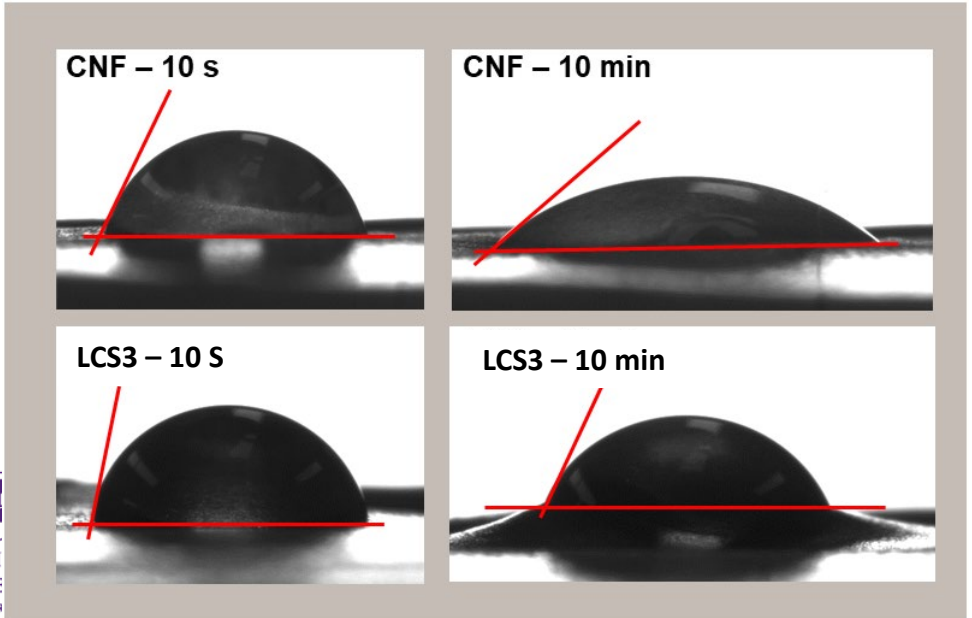
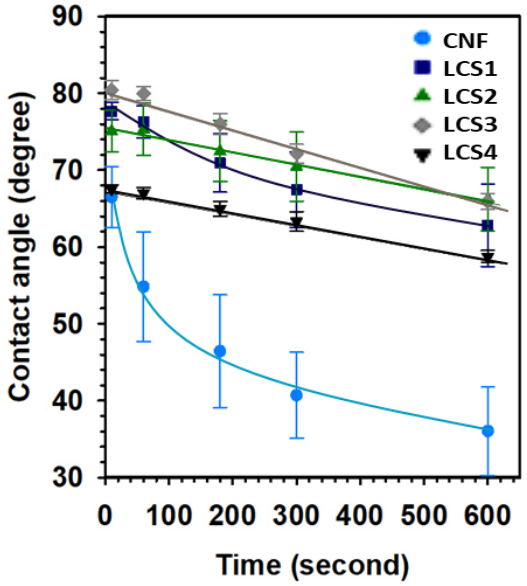




CI= 50-57%

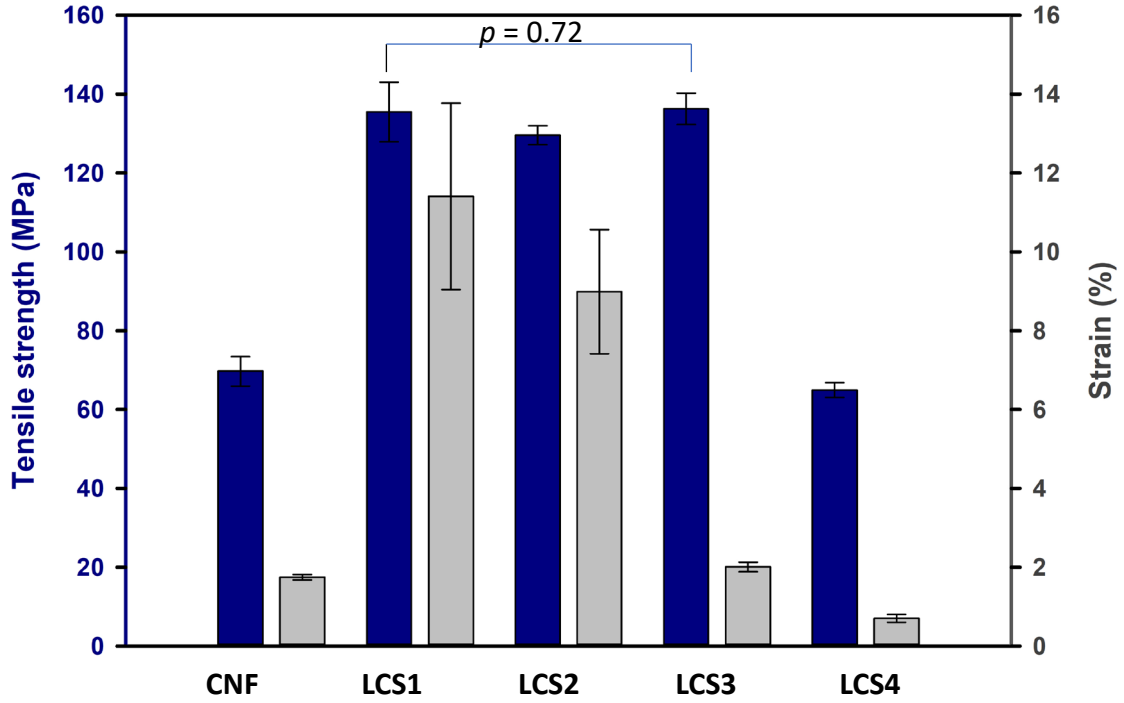




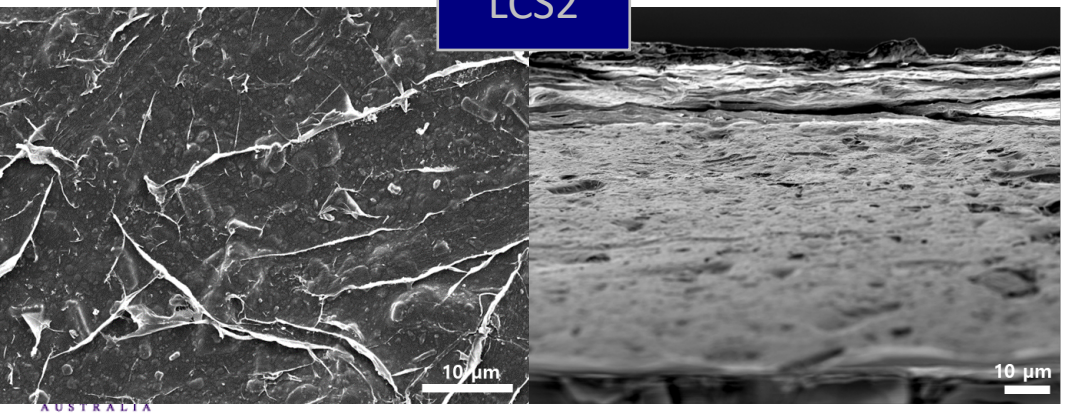
Significant factor

Initial contact: entrap air
Overtime: hydrophobic nature

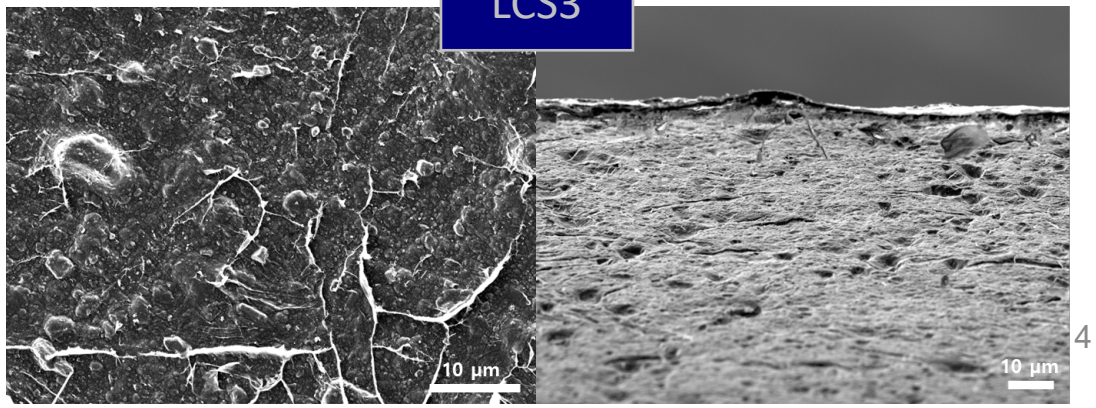
Nanosheet properties



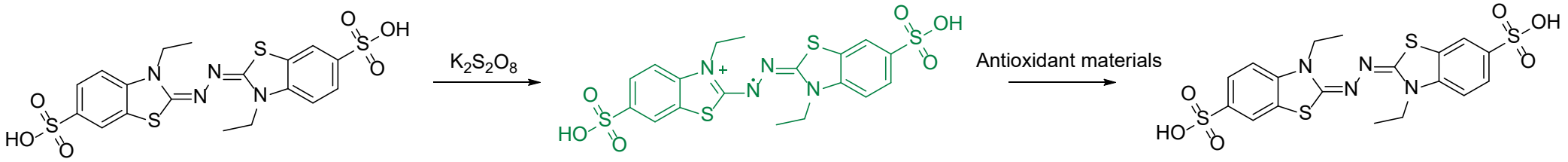
LCS2



LCS3



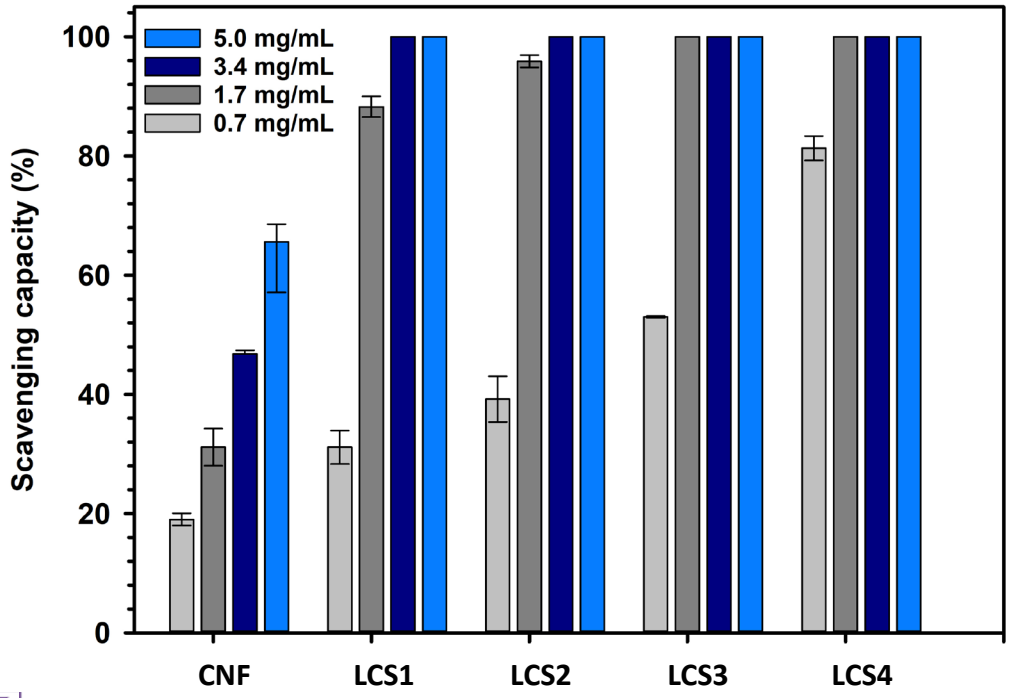
Antioxidant properties



2,2'-azino-bis(3-ethylbenzothiazoline-6sulphonic acid)

ABTS• Green colour

ABTS Colourless



Long term capacity analysis

From left; CNF, LCS1, LCS2, LCS3, LCS4

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Summary

- Agricultural waste is a valuable source of material for the production of sustainable and biodegradable packaging
- DES could be an environmentally friendly option to treat biomass for packaging
- There is an optimised condition to synergistically achieve all desirable properties for packaging

Thank you

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