

Strategies on improving flame retardancy of cellulose nanofibrils aerogel

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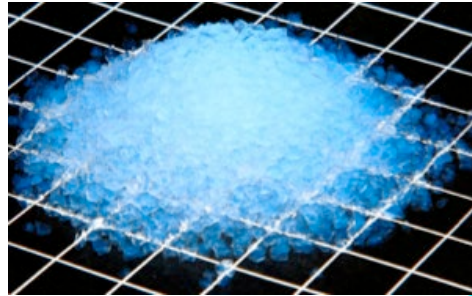
Aerogels - materials selections

Inorganic

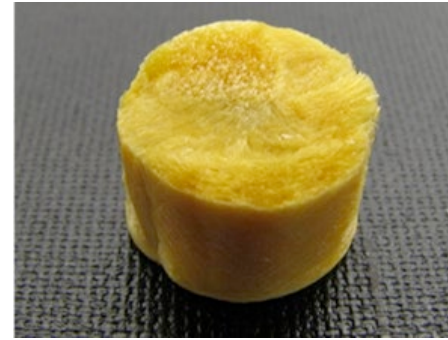


www.buyaerogel.com

Brittleness



Polymeric



Non-degradable



<http://inhabitat.com>

- Aerogel:
- Lightweight
 - Porous
 - 3D network
 - Low λ

Carbonaceous



<https://www.extremetech.com/>

Expensive



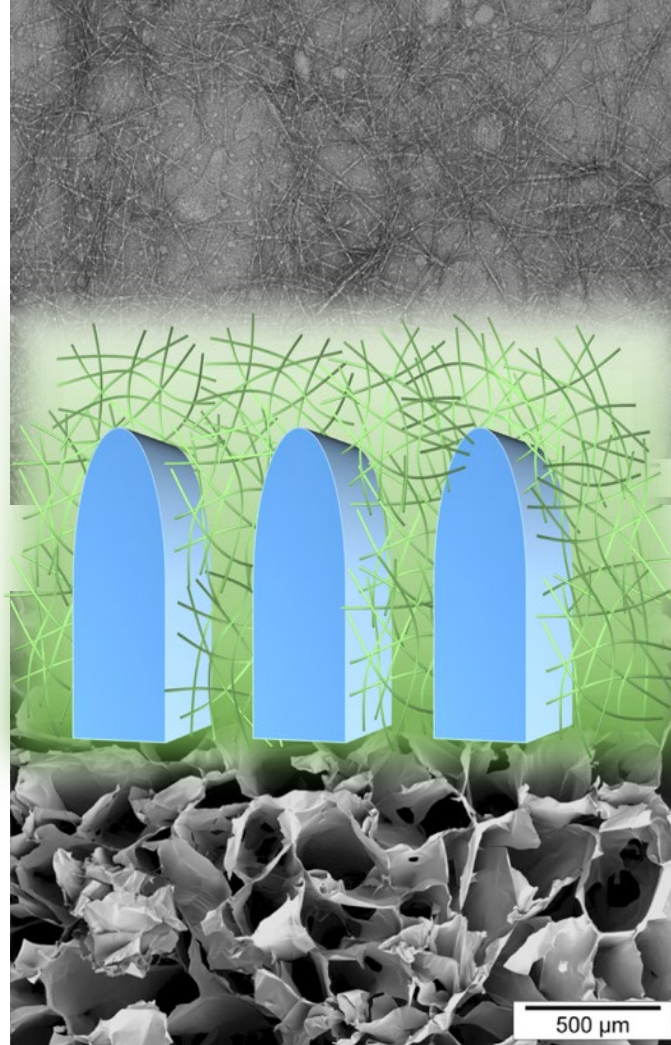
Biobased



- Biodegradable;
- Abundant;
- Low cost;
- Easy to process;



Cellulose nanofibrils aerogel



Characteristics:

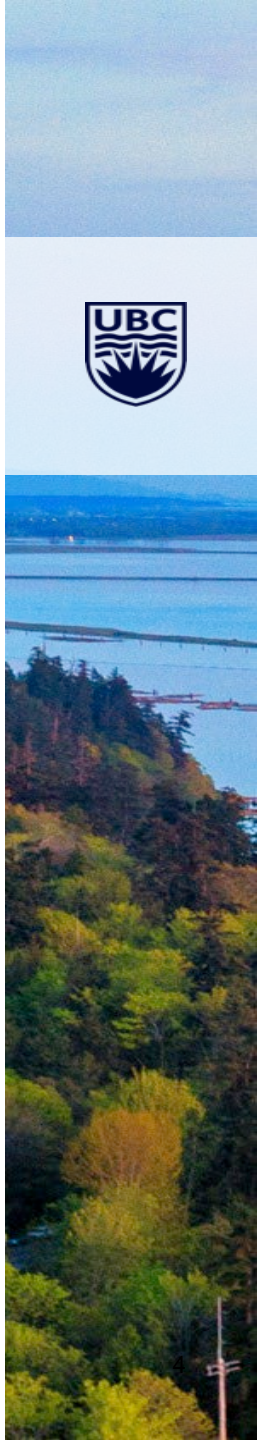
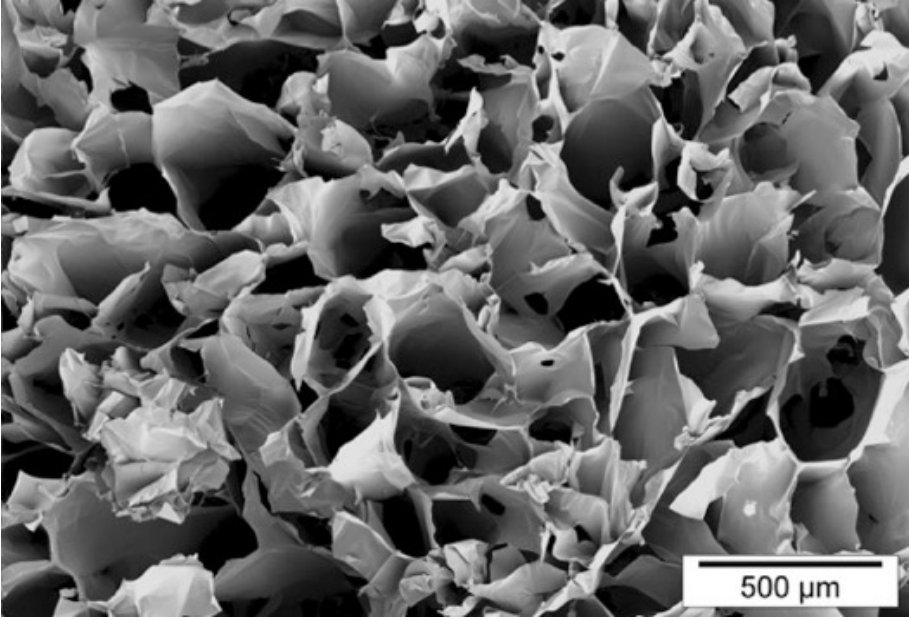
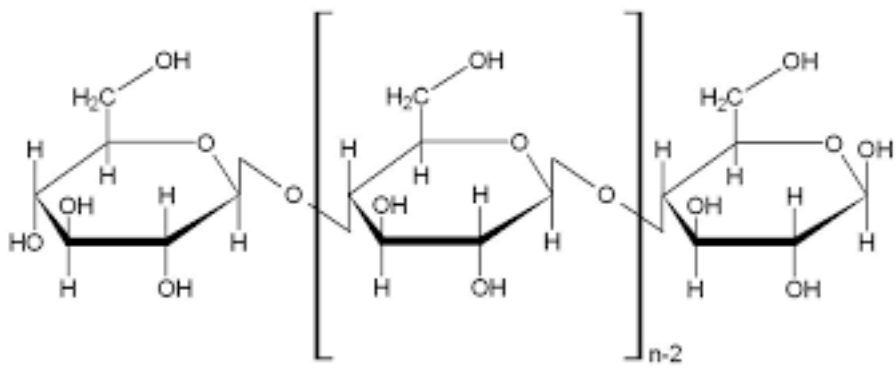
- Long, flexible
- D: < 2 nm, L: up to 1 μm
- Aspect ratio: 500-1000
- Surface charge: 1.29 mmol/g
- Yield: 96%
- Crystallinity: 50-70 %

Properties:

- Low density: 1-10 mg/cm³
- High porosity: as high as 99.9%
- High liquid absorbance
- Large specific surface area

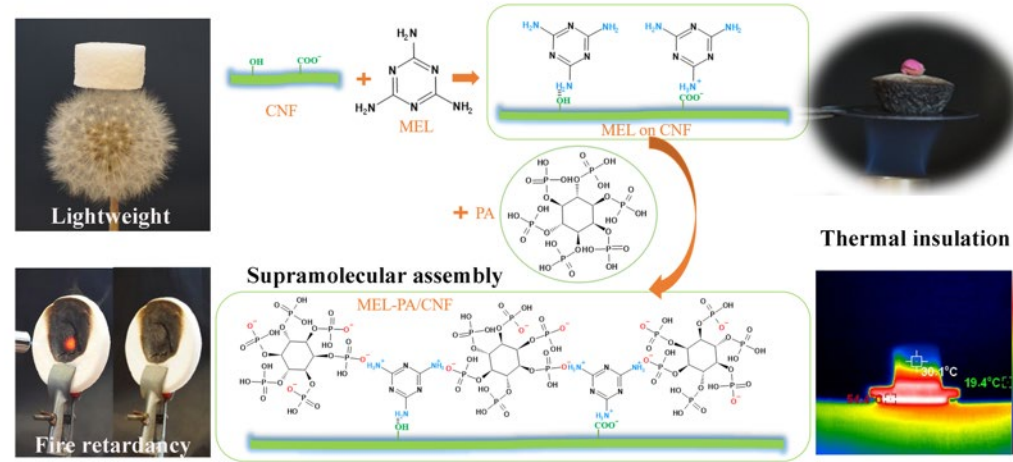


Challenges for CNF aerogel



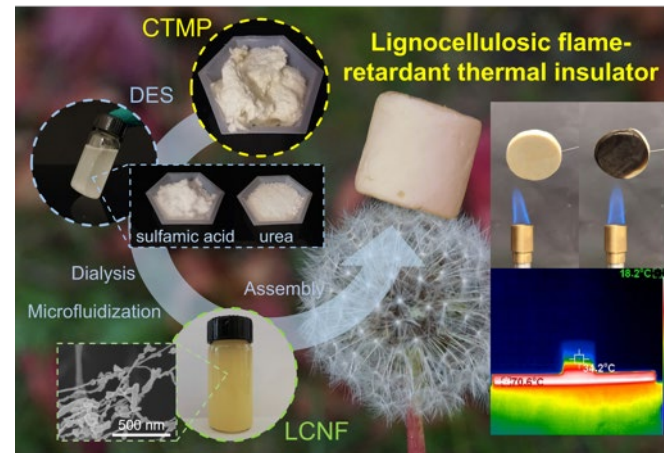
How to address the flammability issue?

- Supramolecular assembly on the aerogel



Adv. Eng. Mater. 2022, 2101534

- Introducing flame retardant performance to the building block



Chem. Eng. J., 2022, 136748

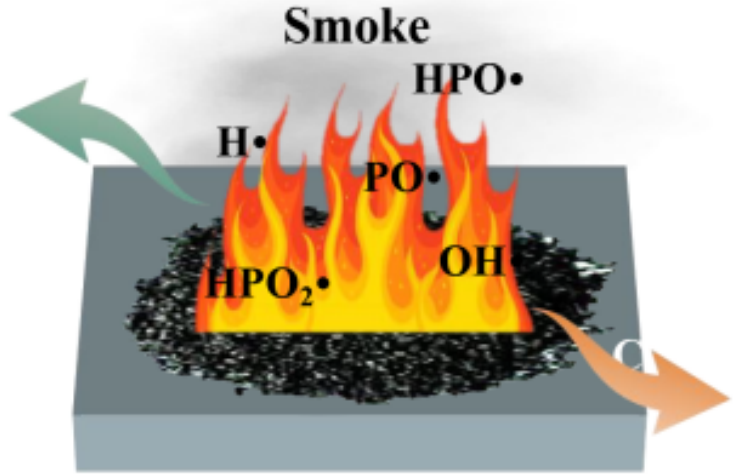
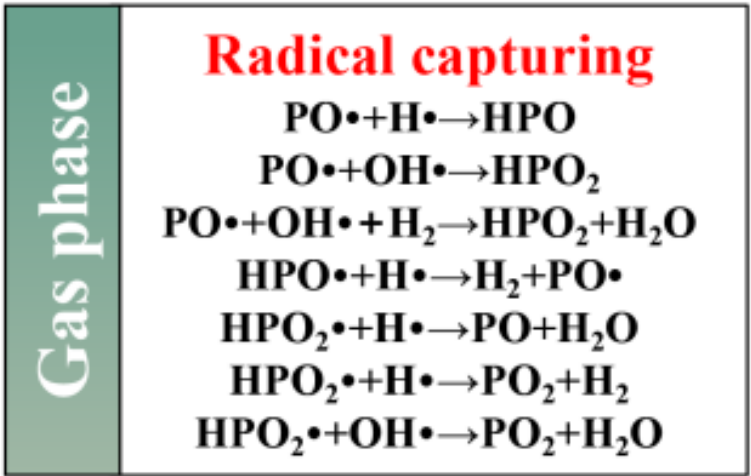
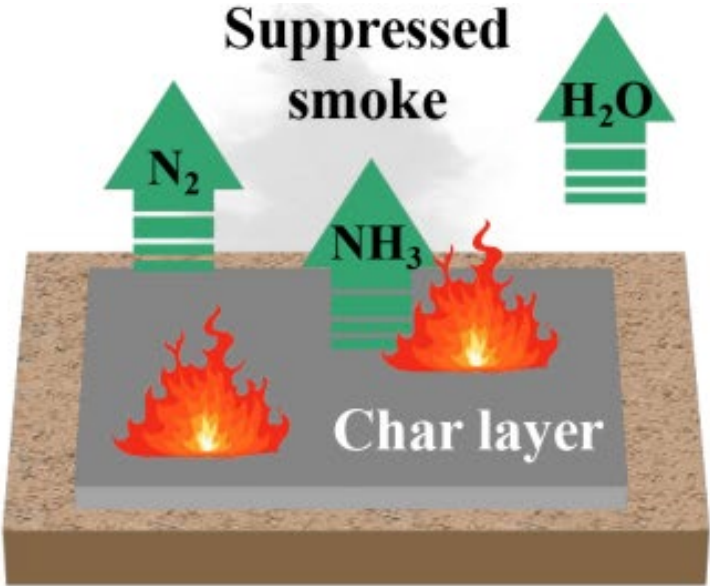


Flame retardancy mechanism – N, P



Gas phase
Combustible gas dilution

Condensed phase
Temperature reduction



Char formation

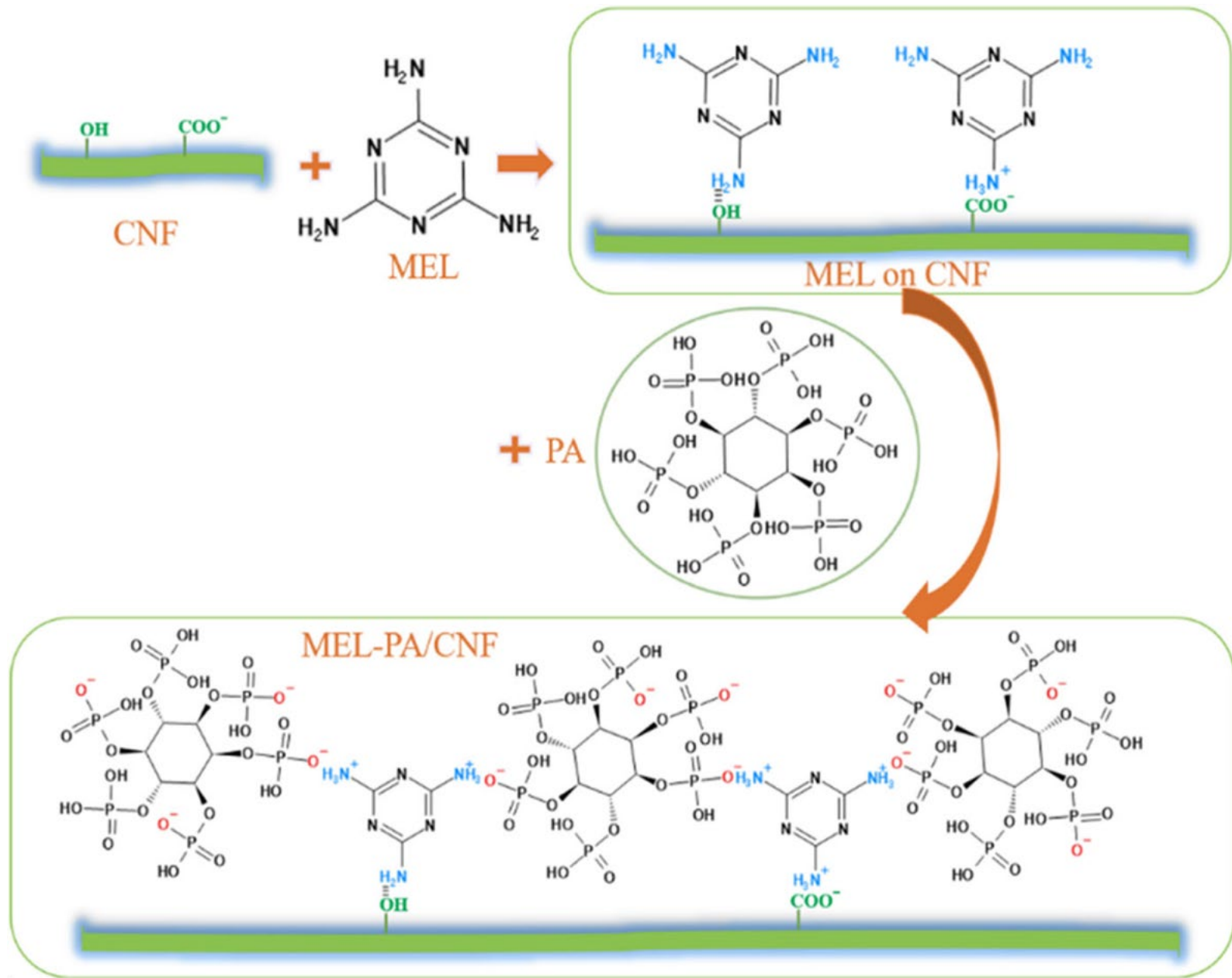
Reduced volatiles release

Suppressed heat release

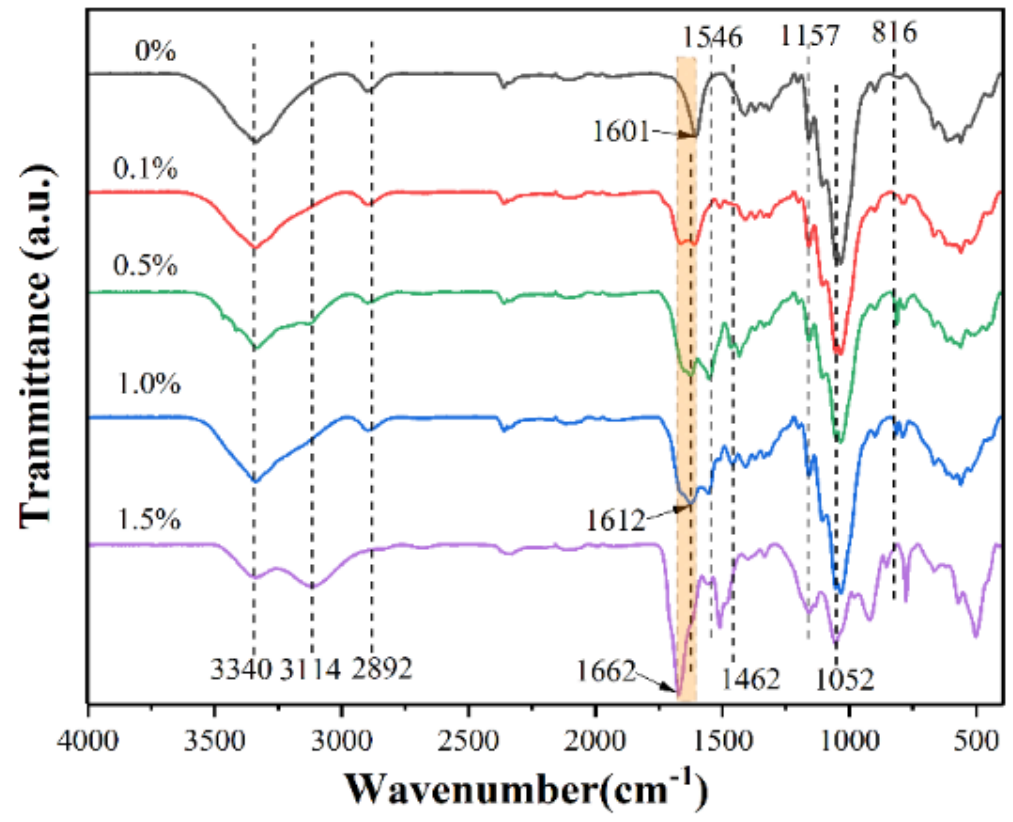
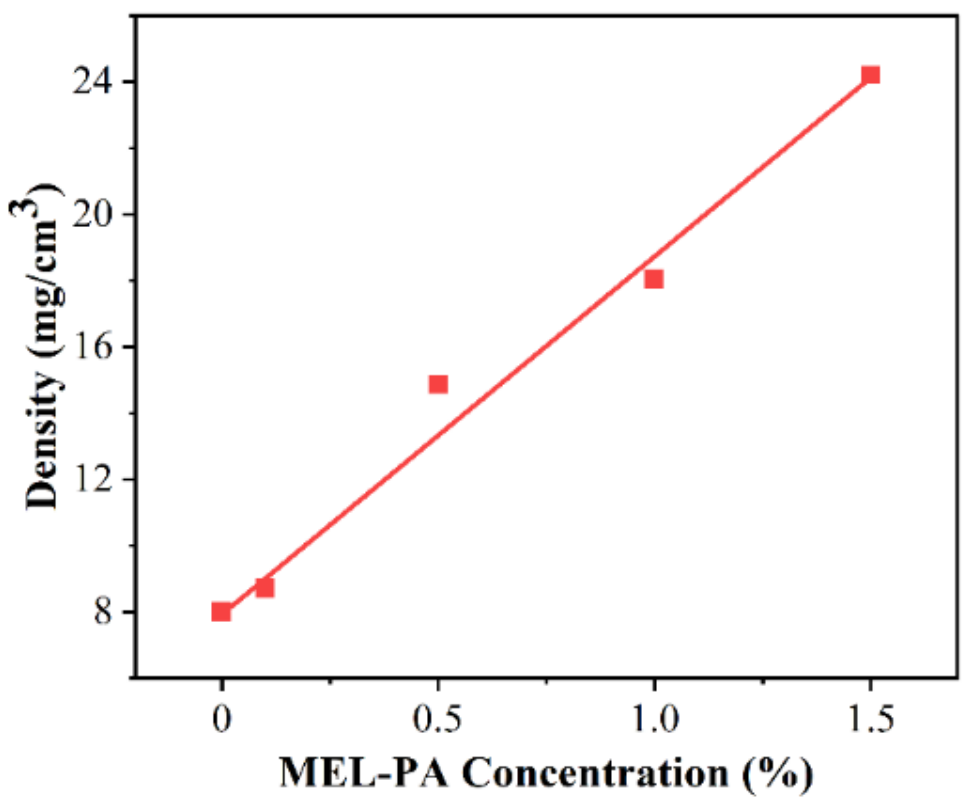
Condensed phase



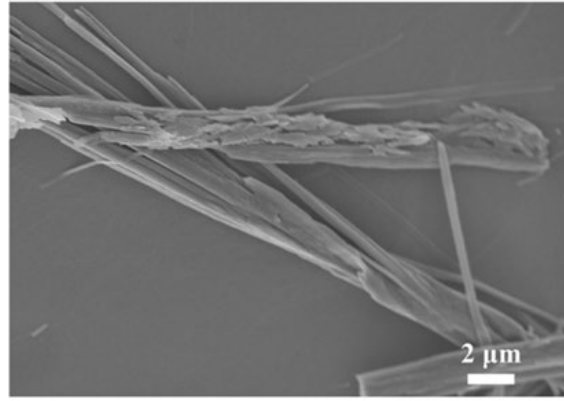
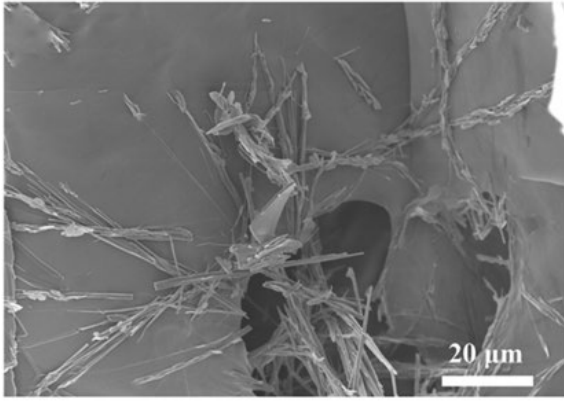
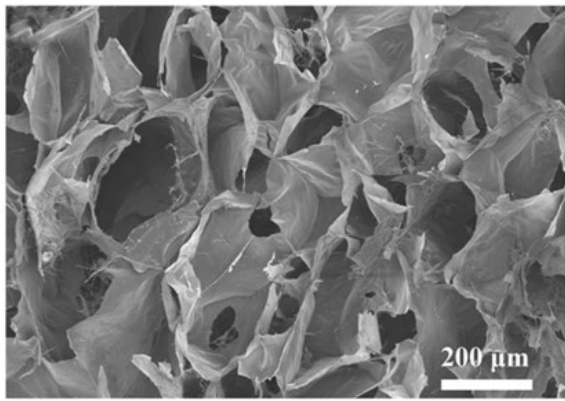
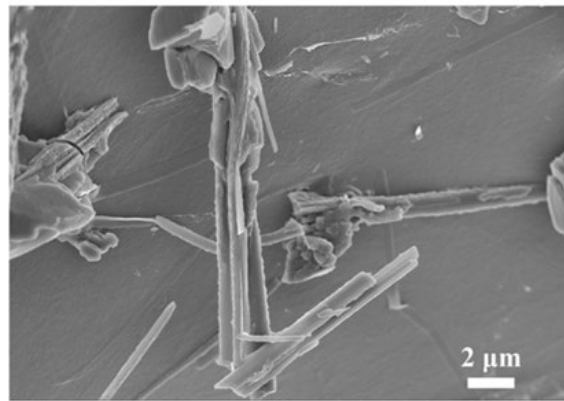
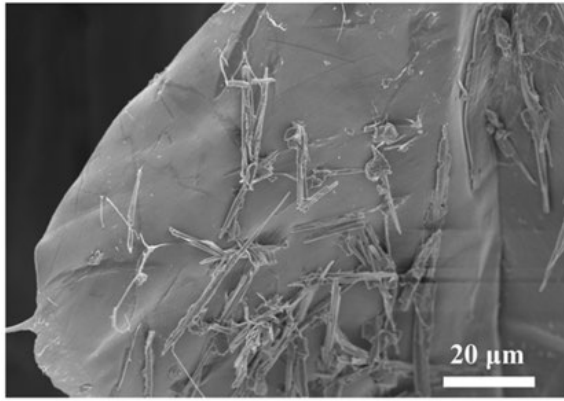
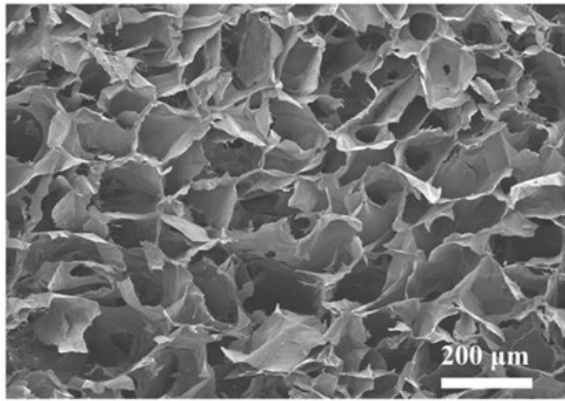
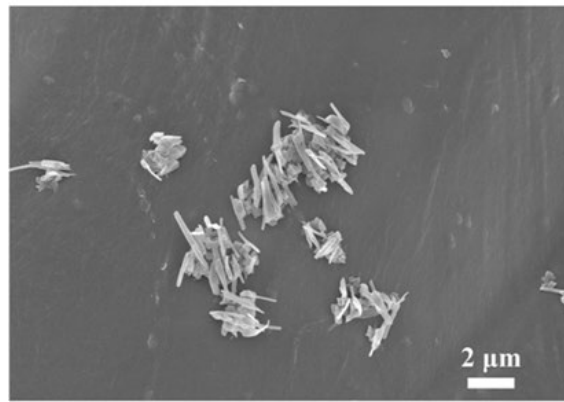
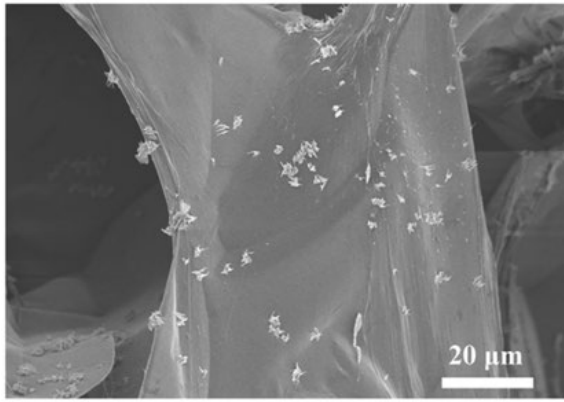
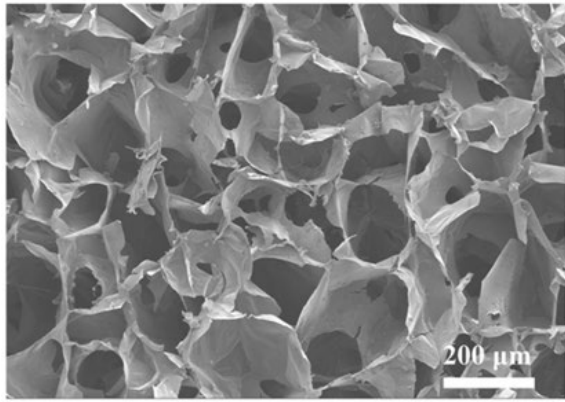
Supramolecular assembly on the aerogel



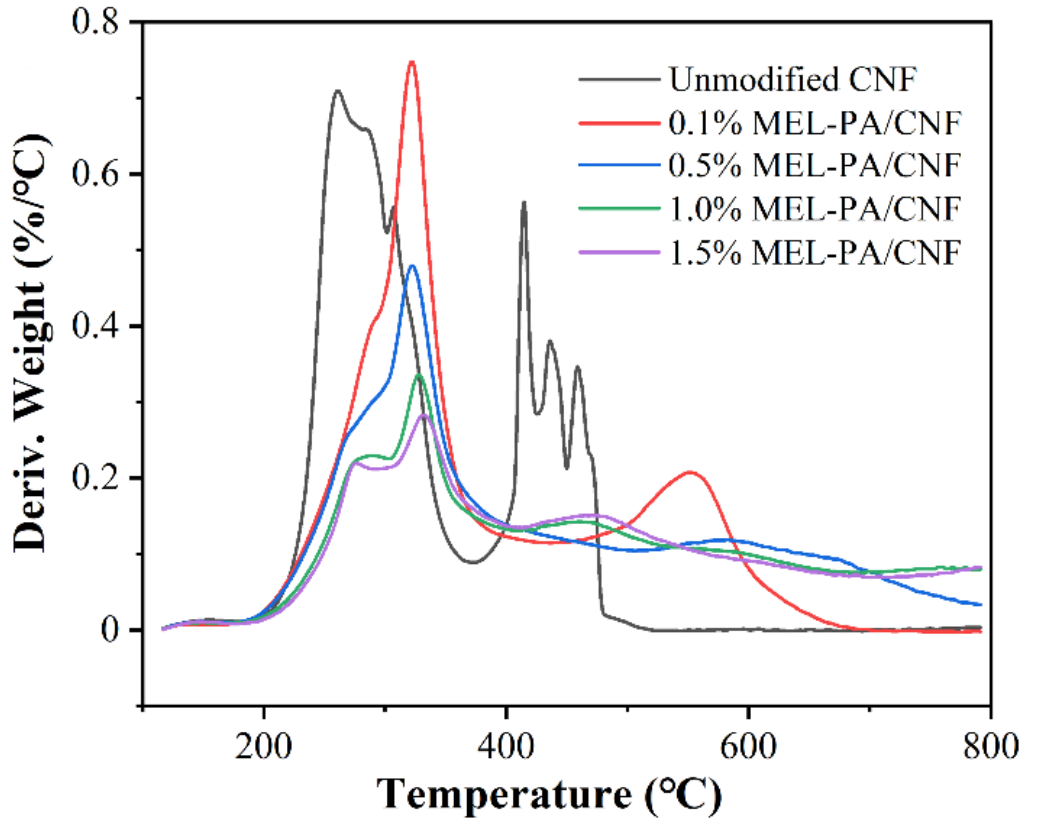
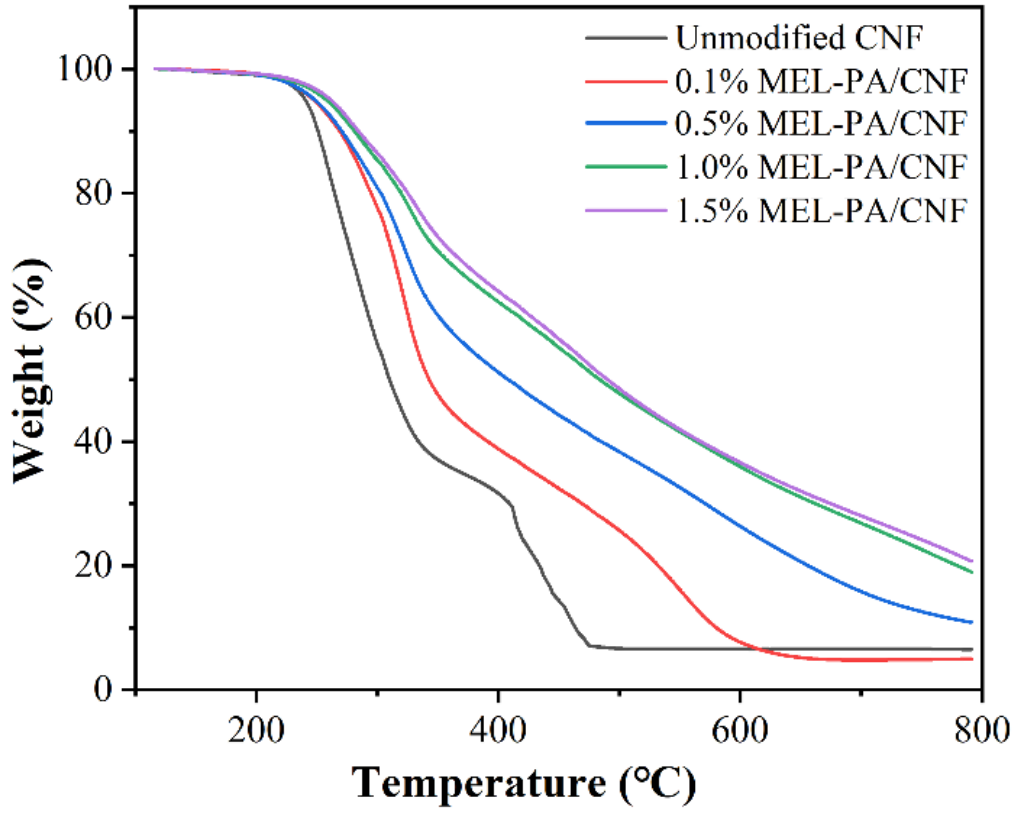
Supramolecular assembly on the aerogel



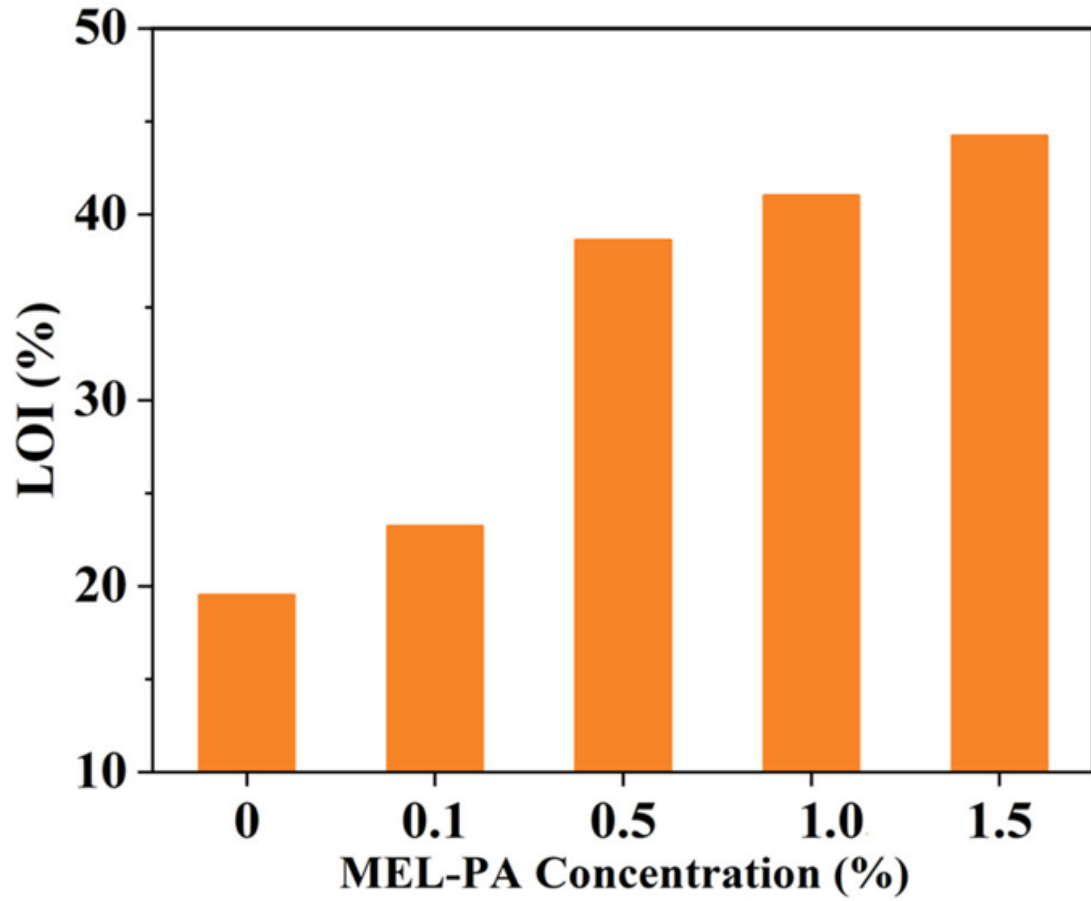
SEM images of the assembled aerogel



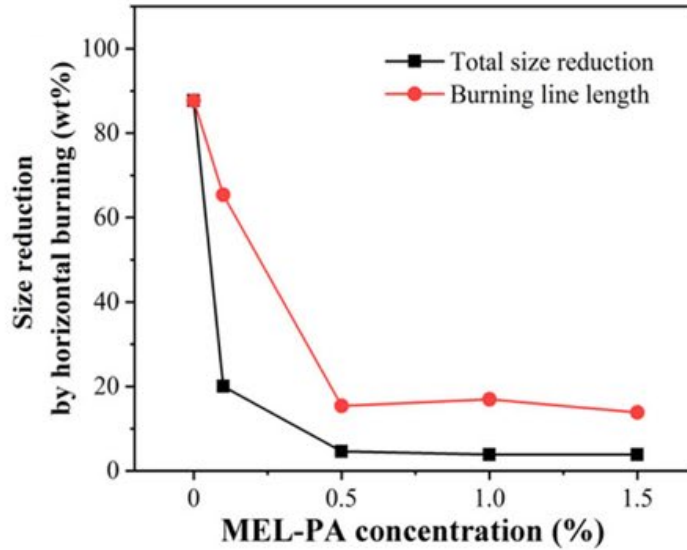
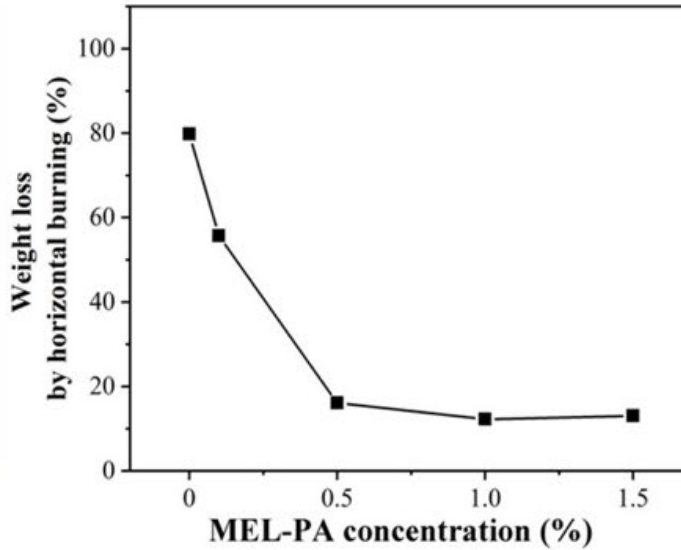
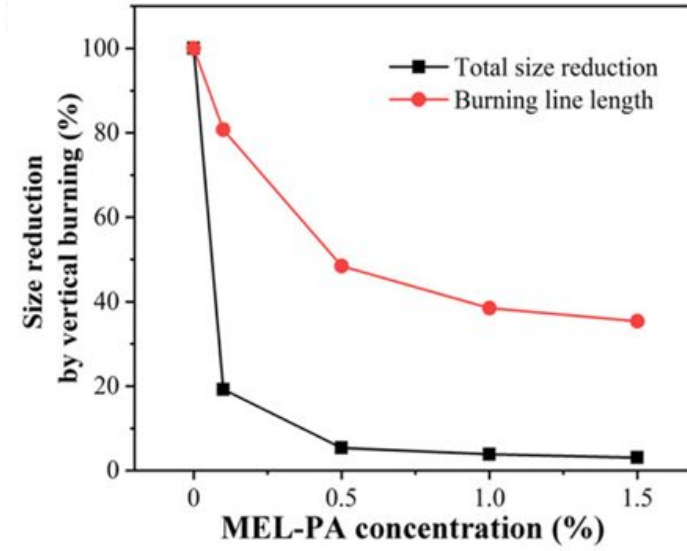
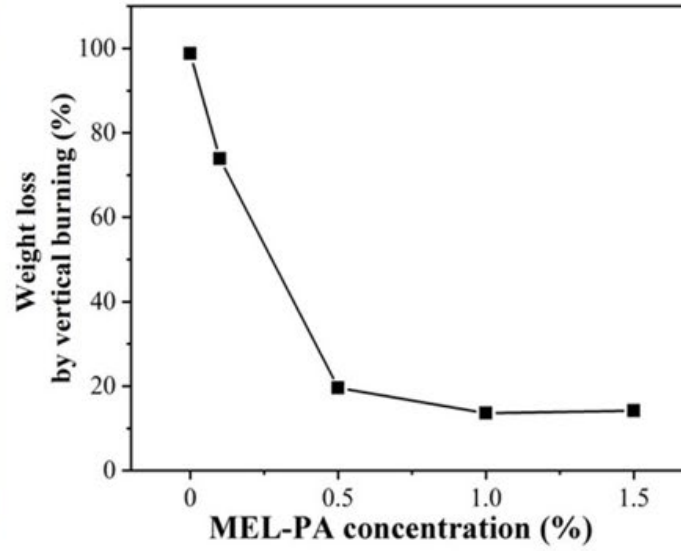
Thermal stability



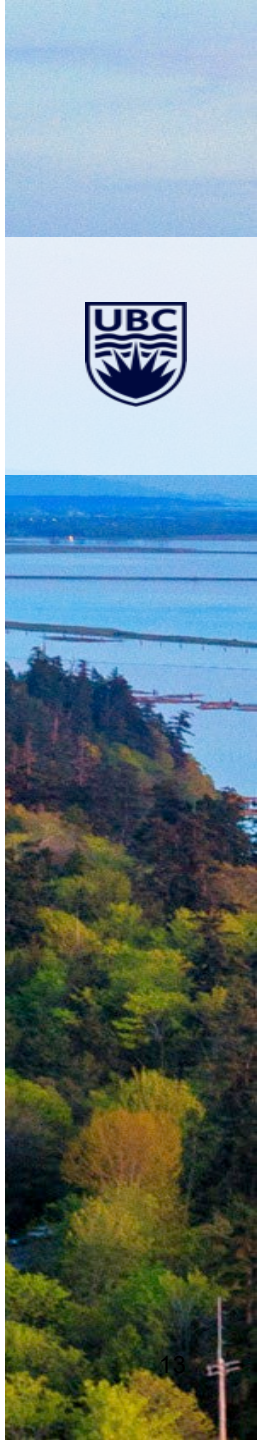
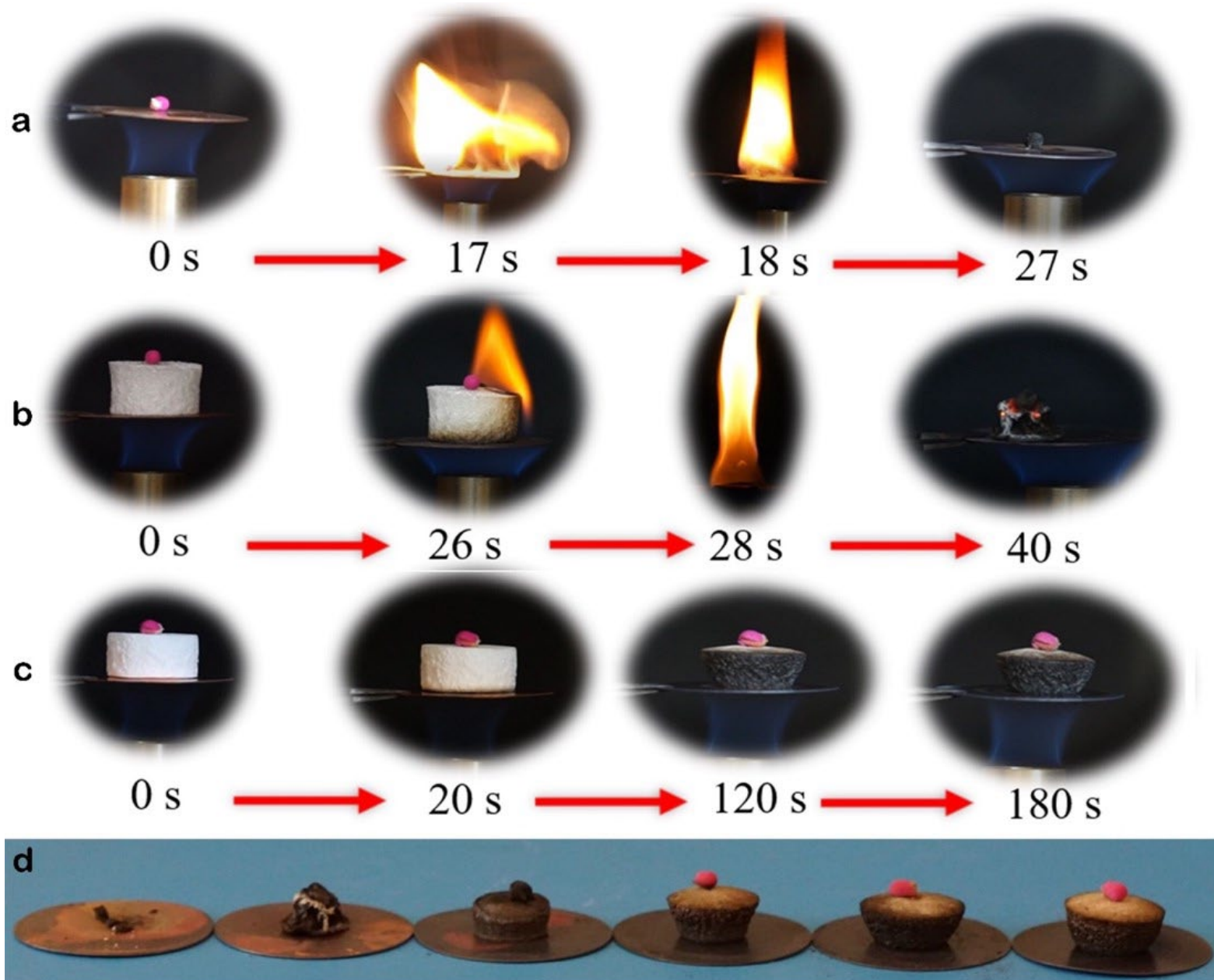
Flame-retardant performance



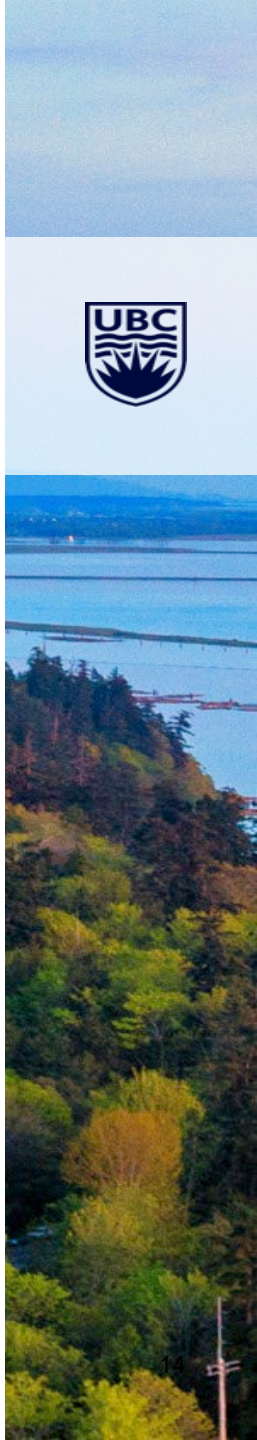
Flame-retardant performance



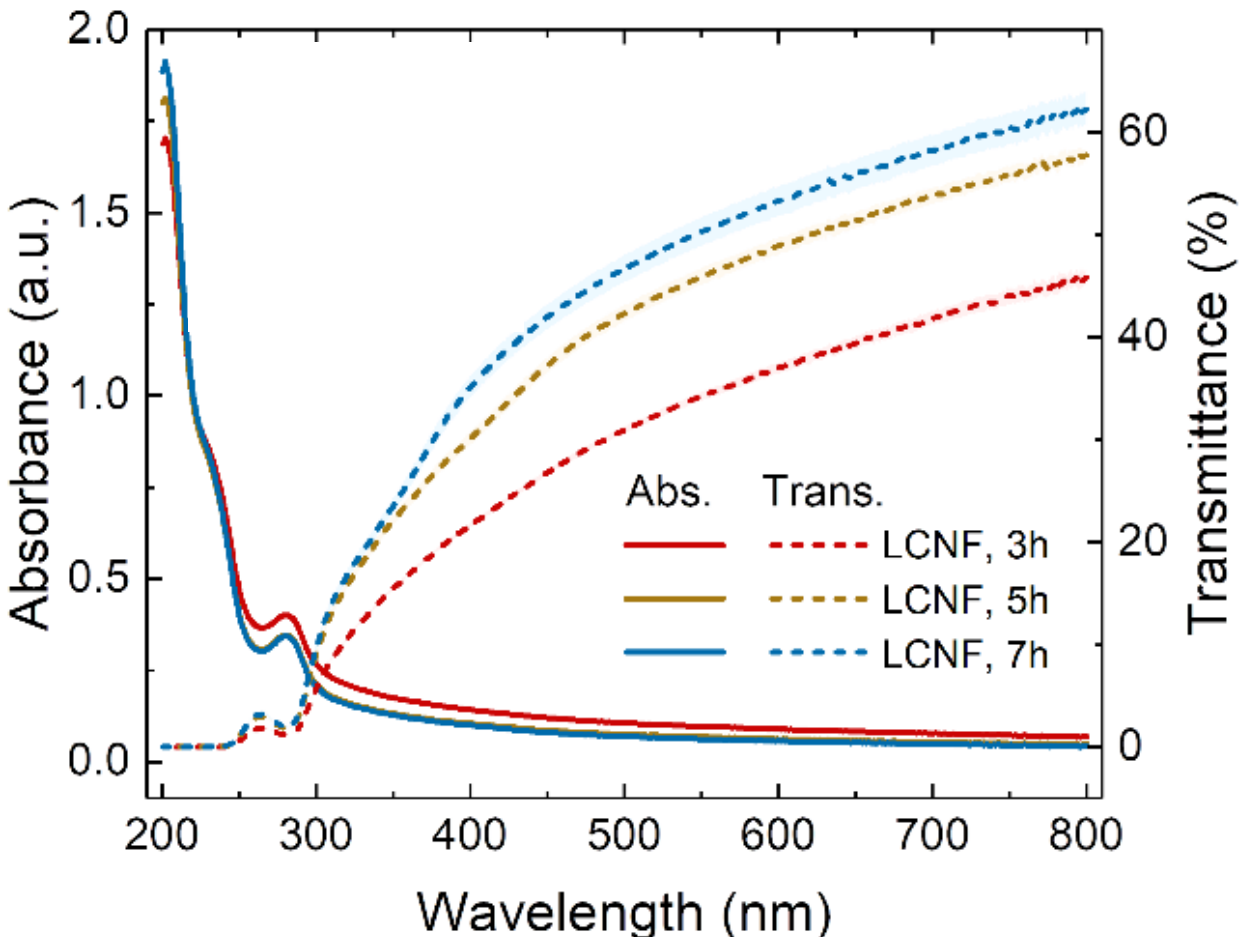
Heat resistance



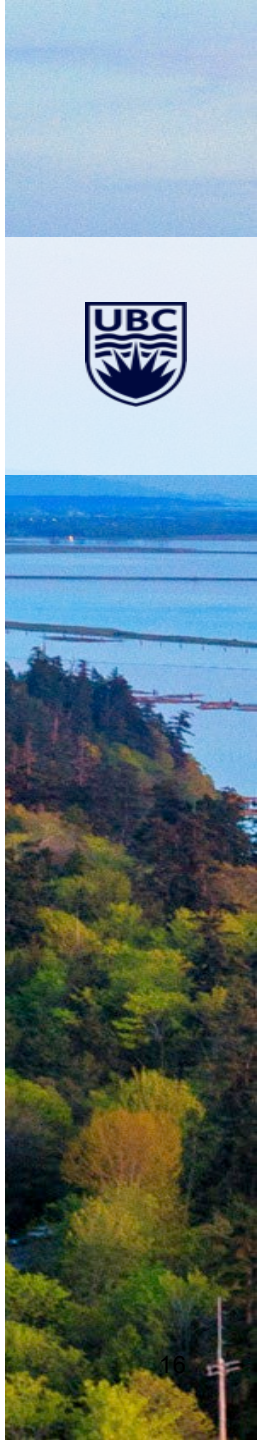
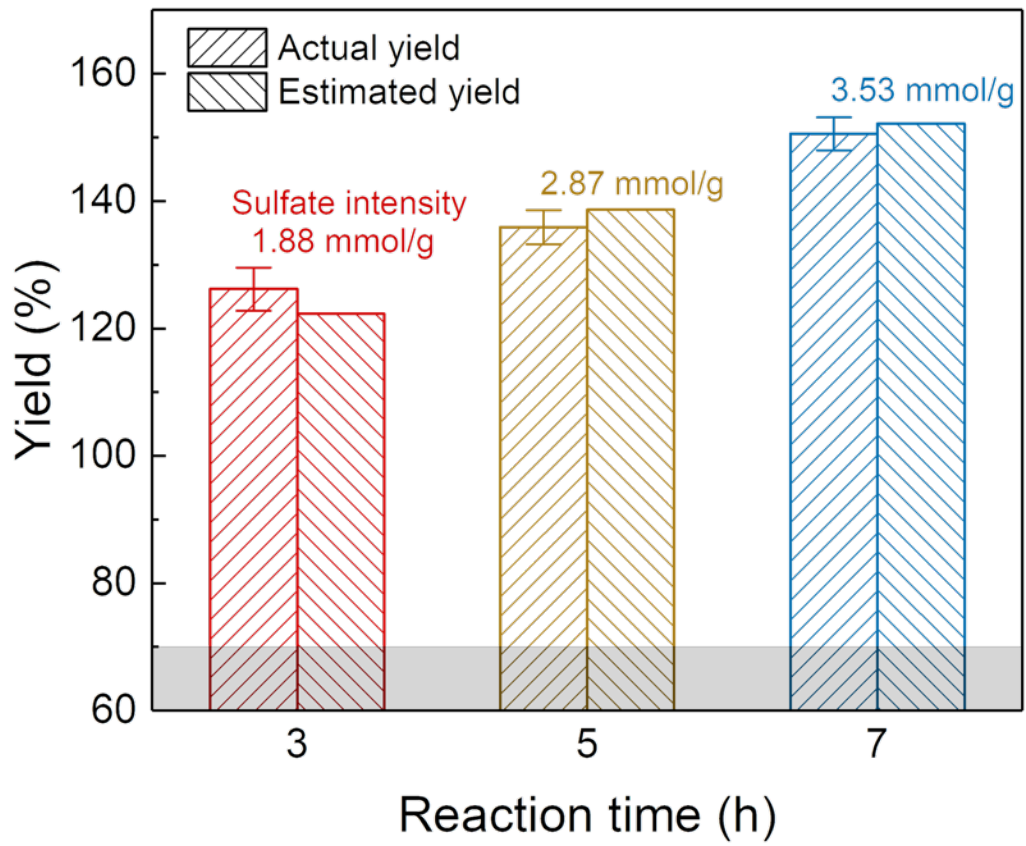
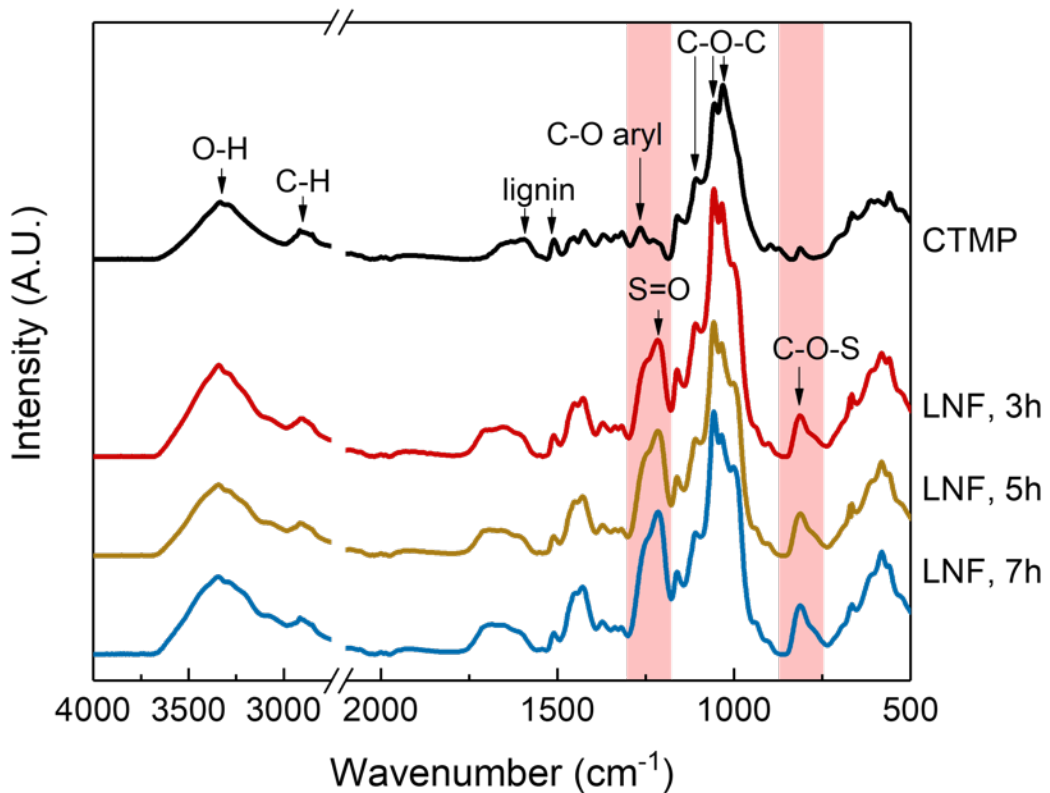
Introducing flame retardant performance to the building block



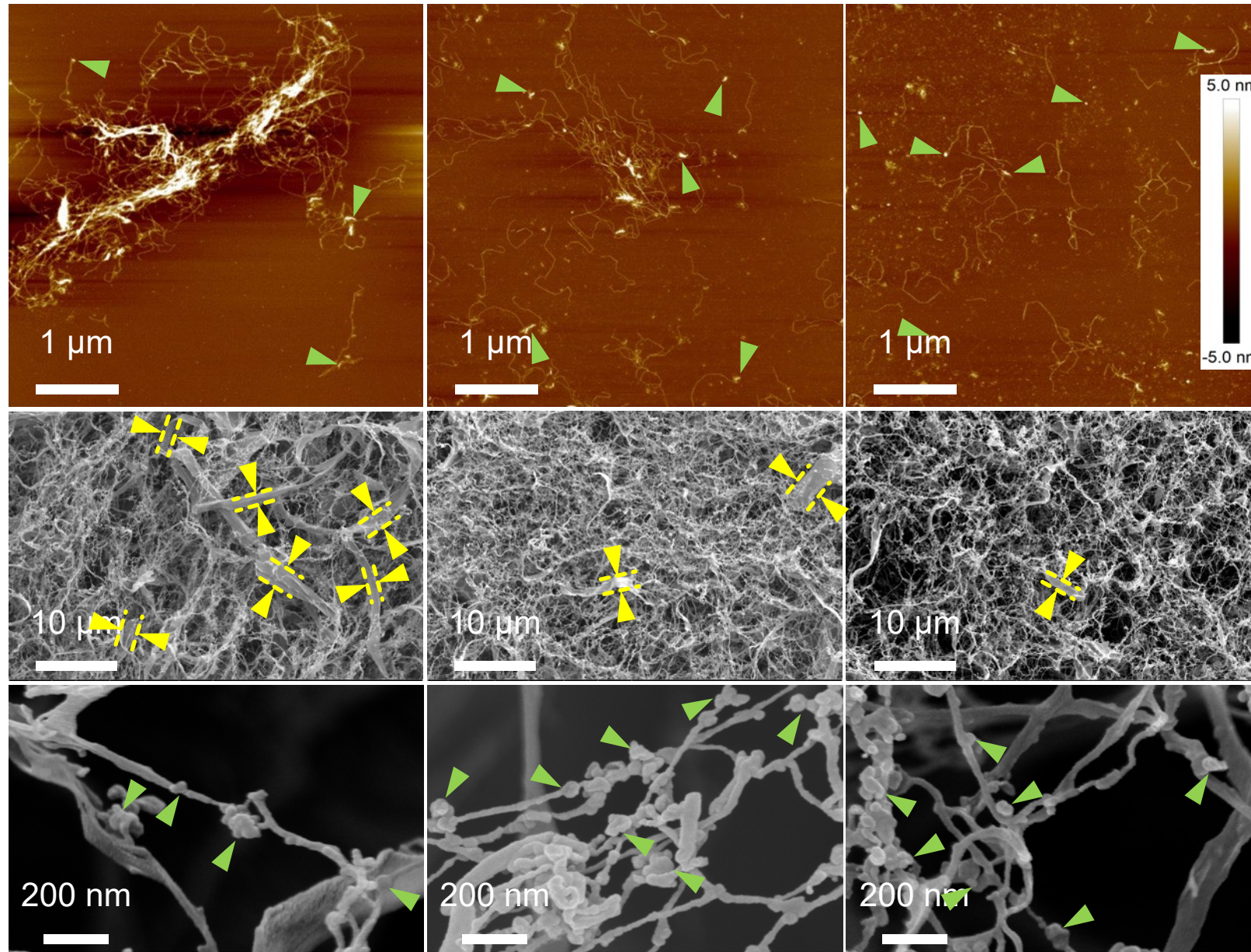
Characterization of LCNFs



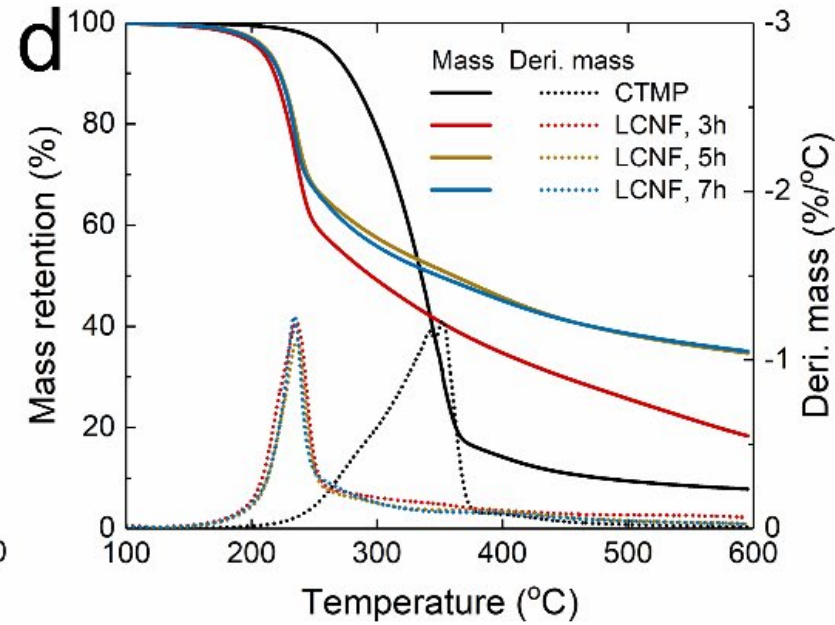
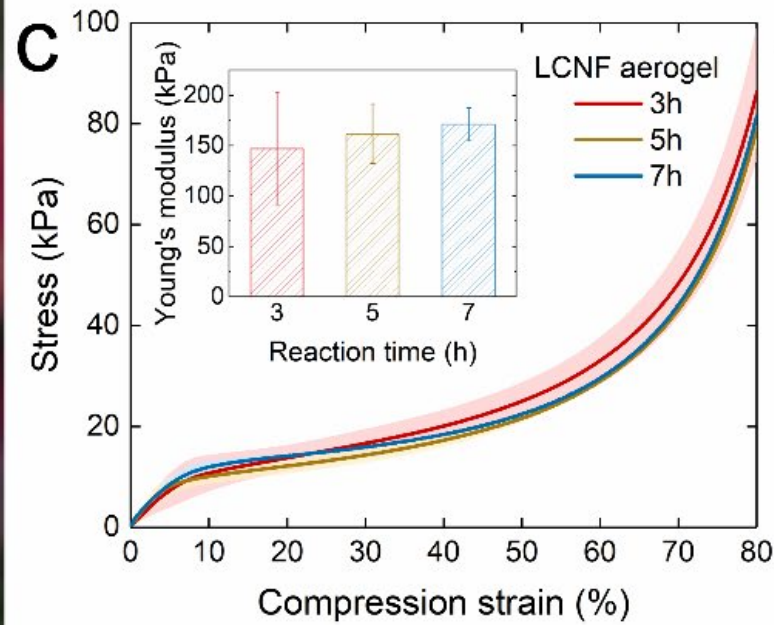
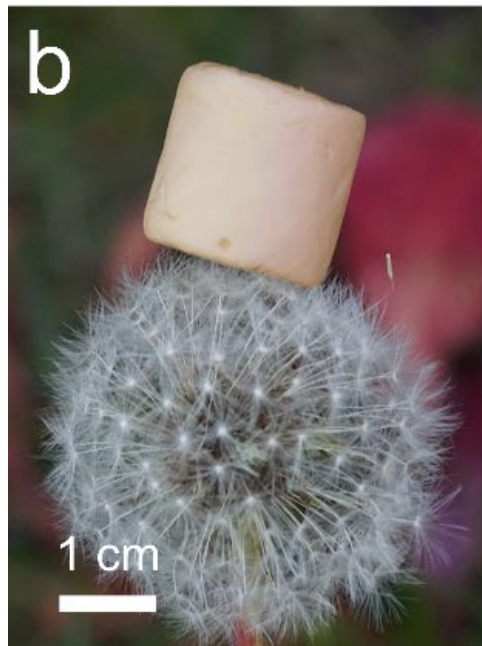
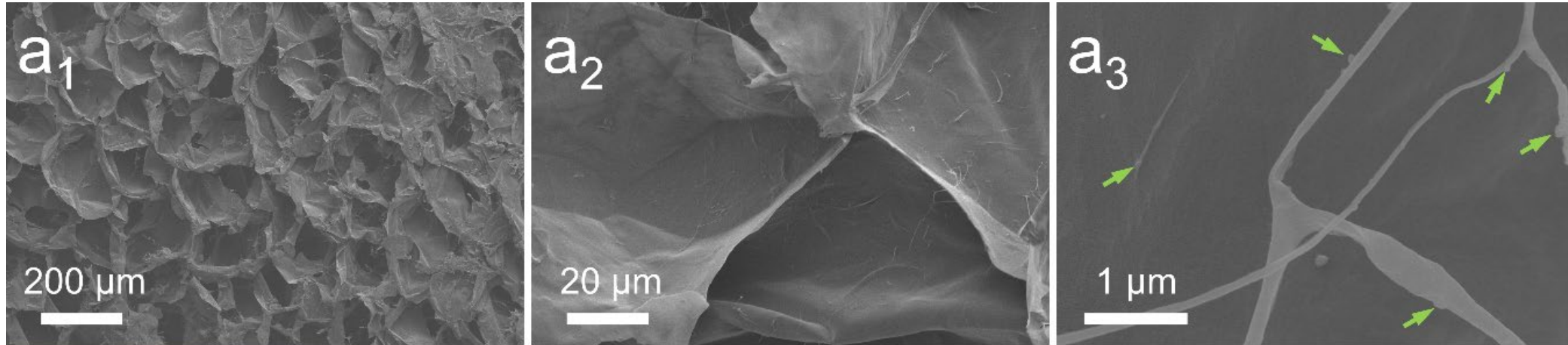
Characterization of LCNFs



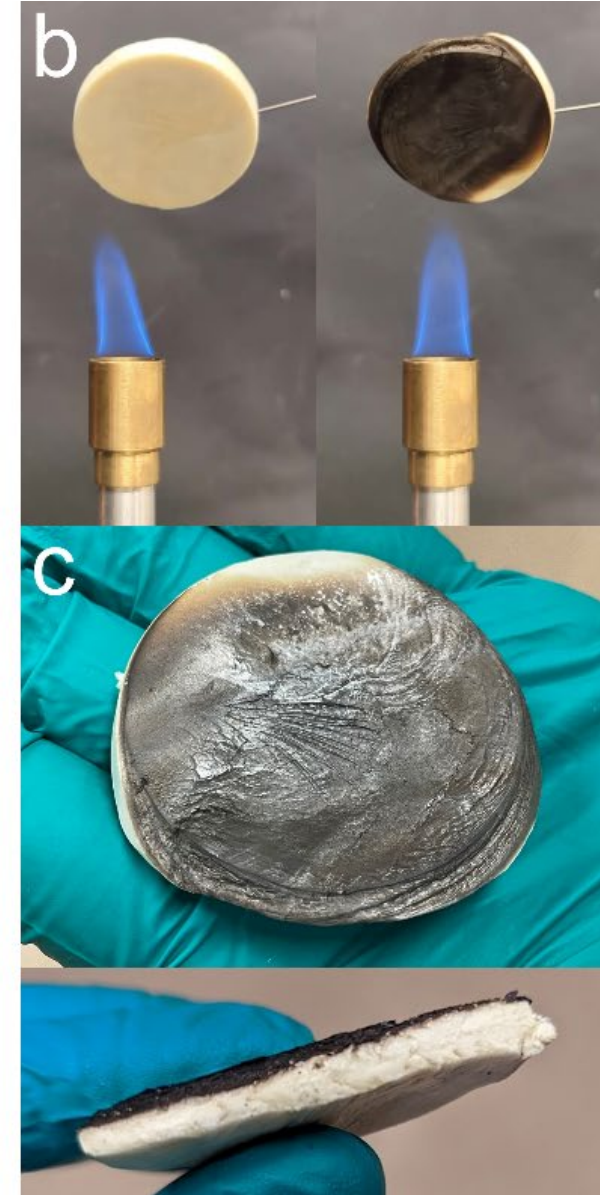
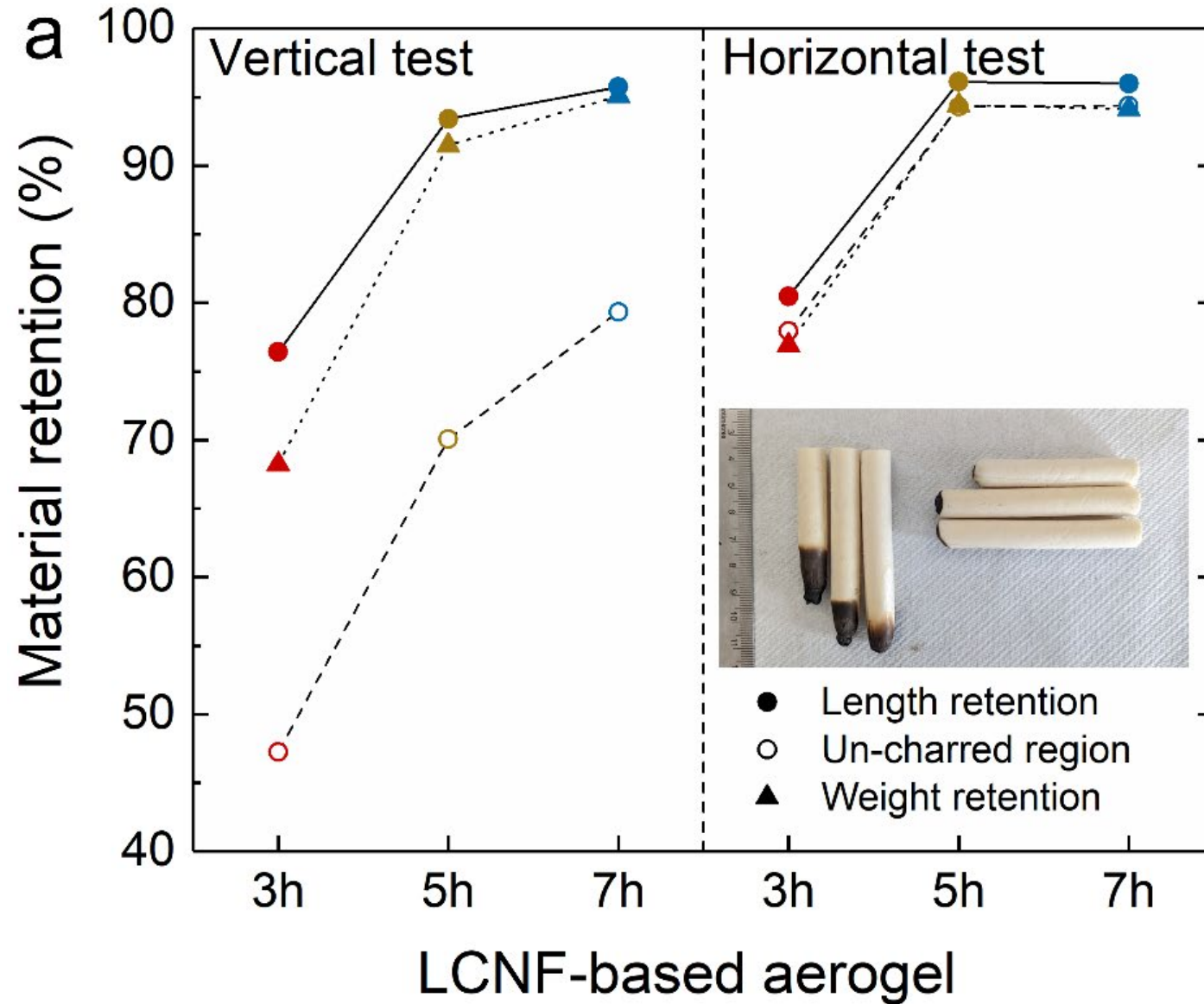
Morphologies of LCNFs



LCNFs aerogel



Flame retardancy performance



Acknowledgement



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a place of mind



Thank you for your attentions!

Questions?

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