

Dialcohol Cellulose Nanocrystals Enhanced Polymerizable Deep Eutectic Solvent-Based Self-Healing Ion Conductors with Ultra-Stretchability and Sensitivity

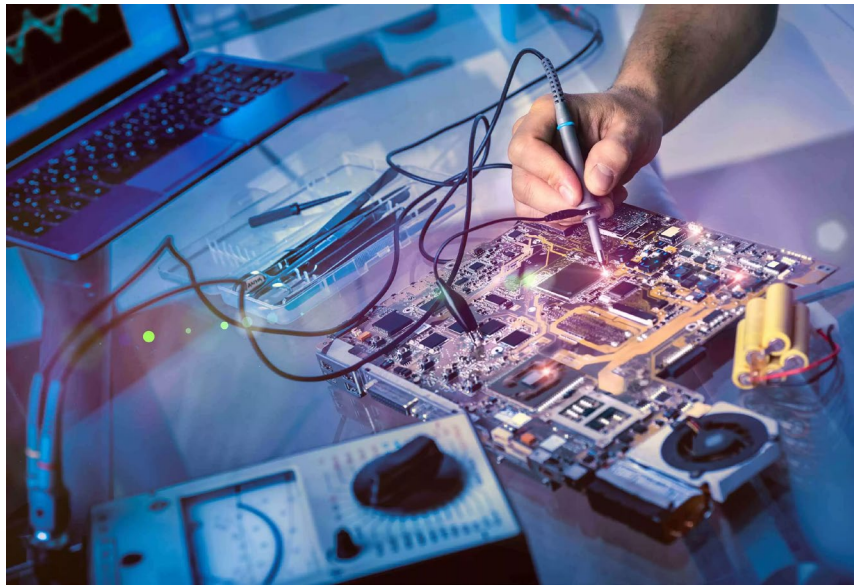
Xia Sun

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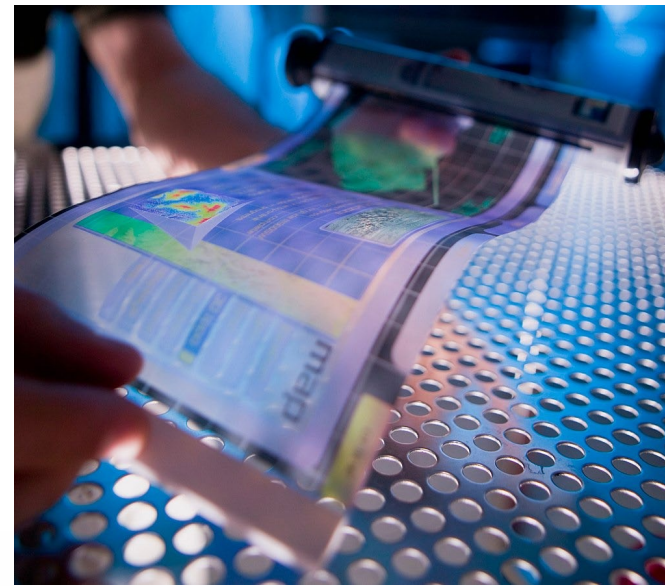
Department of wood science
Faculty of forestry



Flexible electronics convert physical actions into electrical output, which can be easily sent and further processed.



traditional electronics



flexible electronics

- Humidity
- **Strain**
- Temperature
- Pressure



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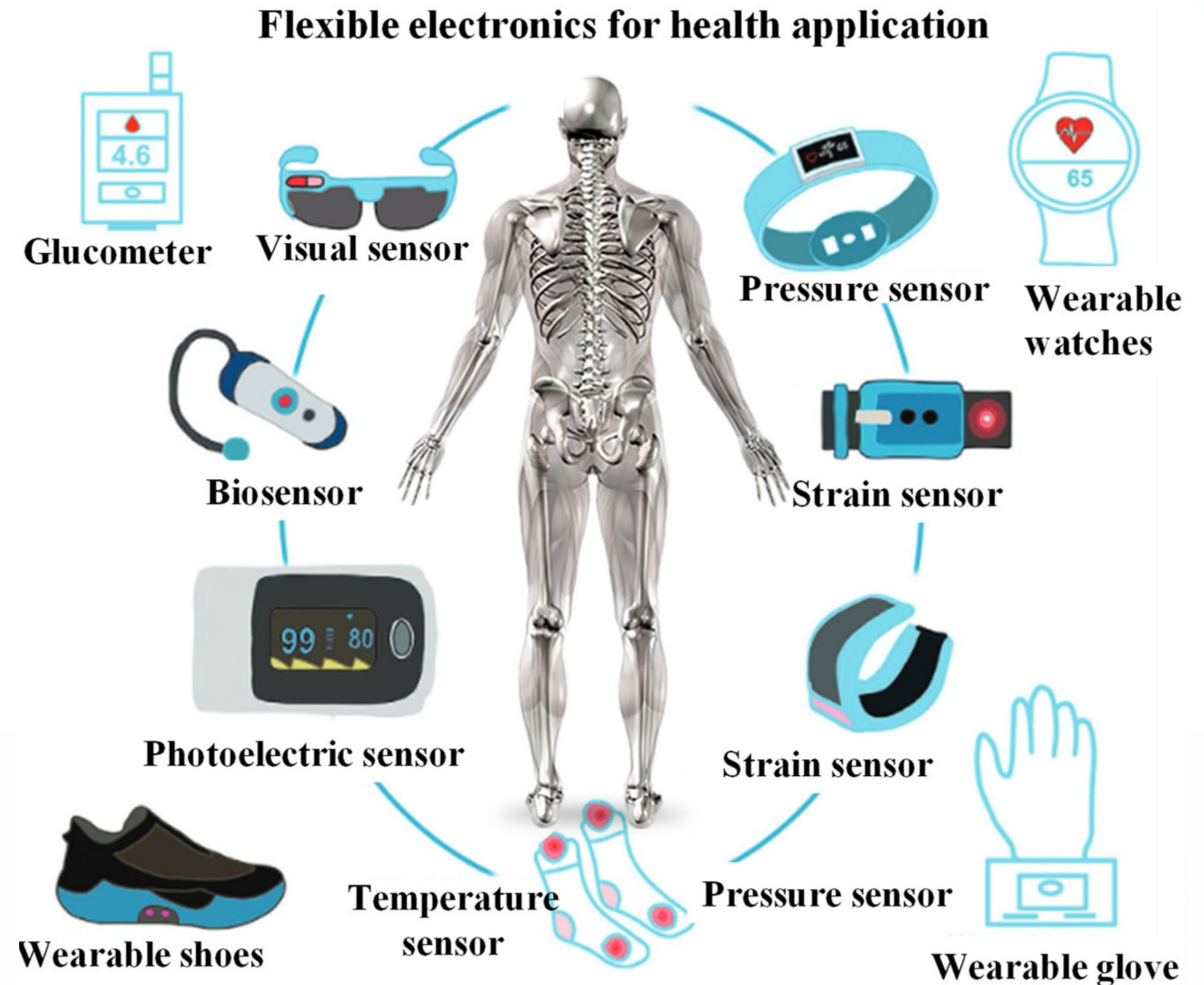


The wearable technology market is projected to reach \$186 billion (USD) by 2030.

Wearable electronics:

Advantages:

- 1) inherent flexibility
- 2) conforming to human body
- 3) designed as a network of sensors



Electronics. 2022; 11(5):716.

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E-waste:

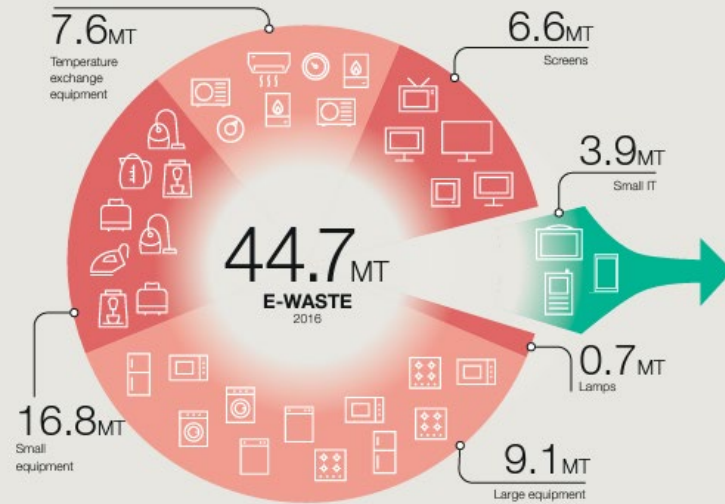
Plastic, Toxic materials, Heavy metal, etc.



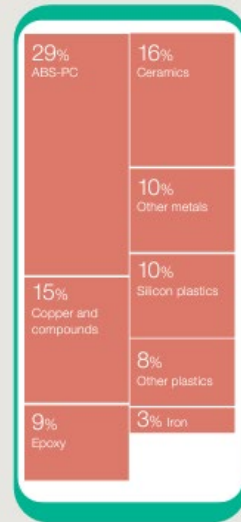
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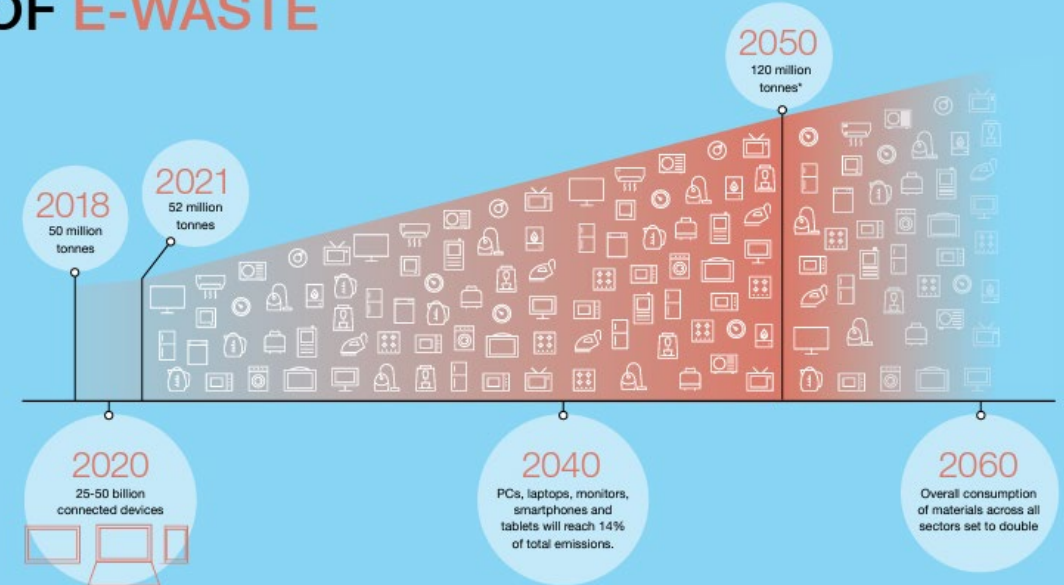
WHAT IS E-WASTE?



What's in a typical mobile phone?



THE FUTURE OF E-WASTE

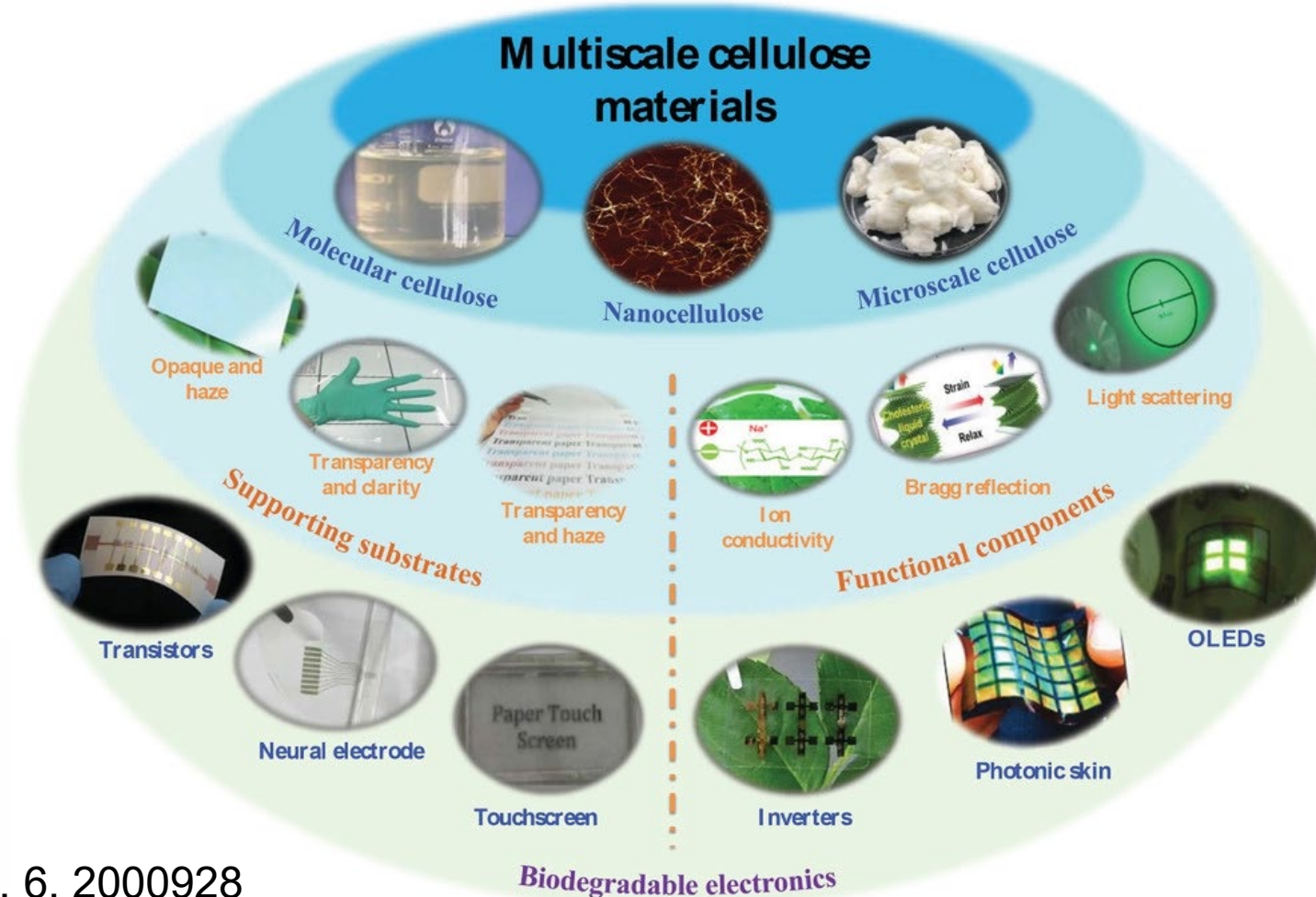


World Economic Forum: A New Circular Vision for Electronics, Time for a Global Reboot

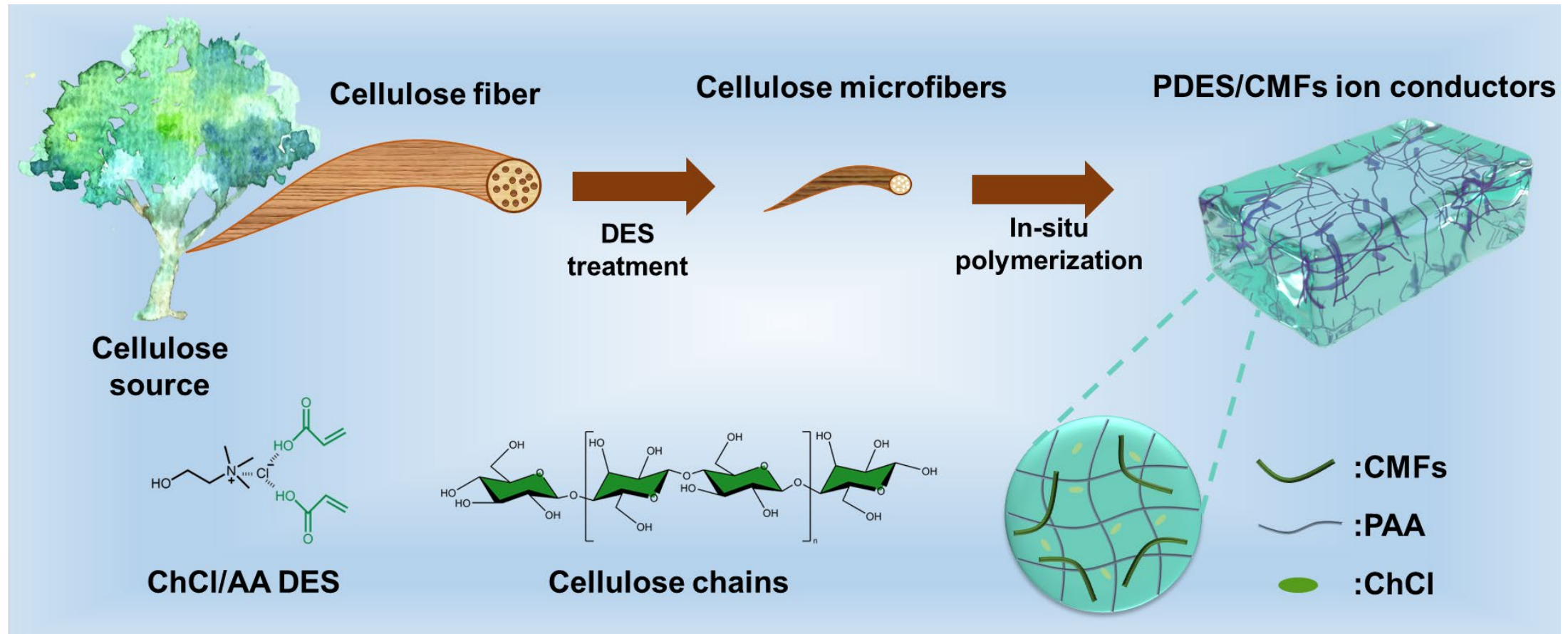


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Cellulose: The most existing bio-polymer in the world.



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Advanced Functional Materials, 2022, 2202533



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Challenge

The dispersion of nanocellulose is not ideal.

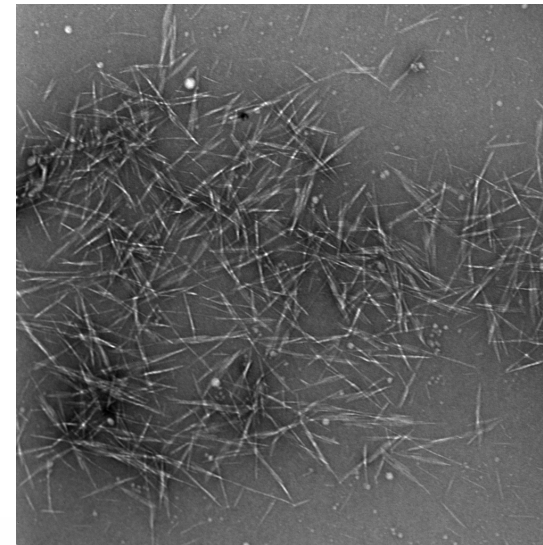
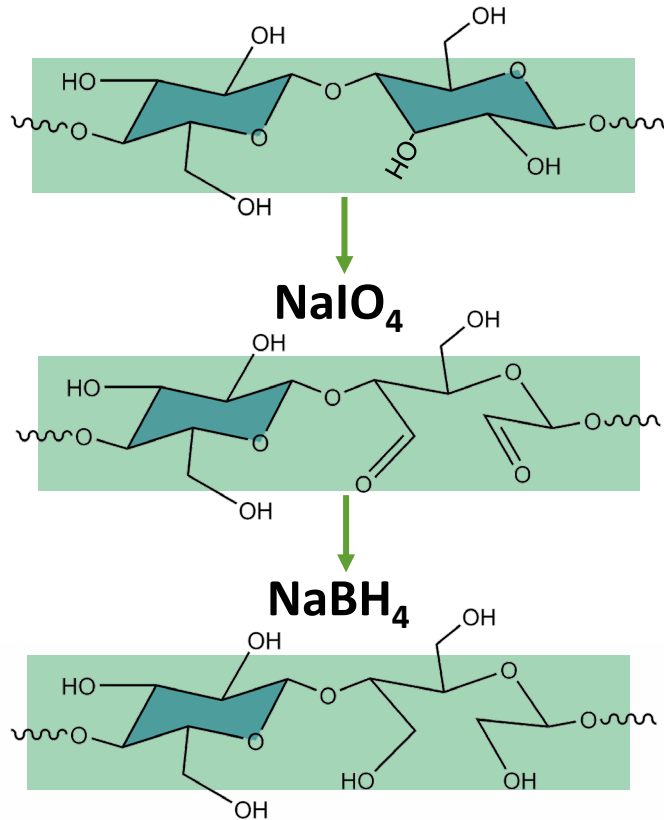
Procedure

Exploring new type of nanocellulose



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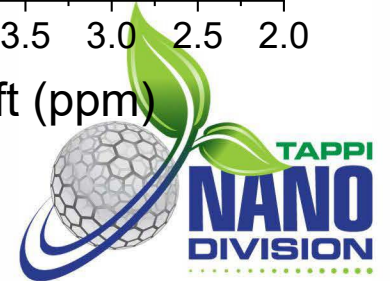
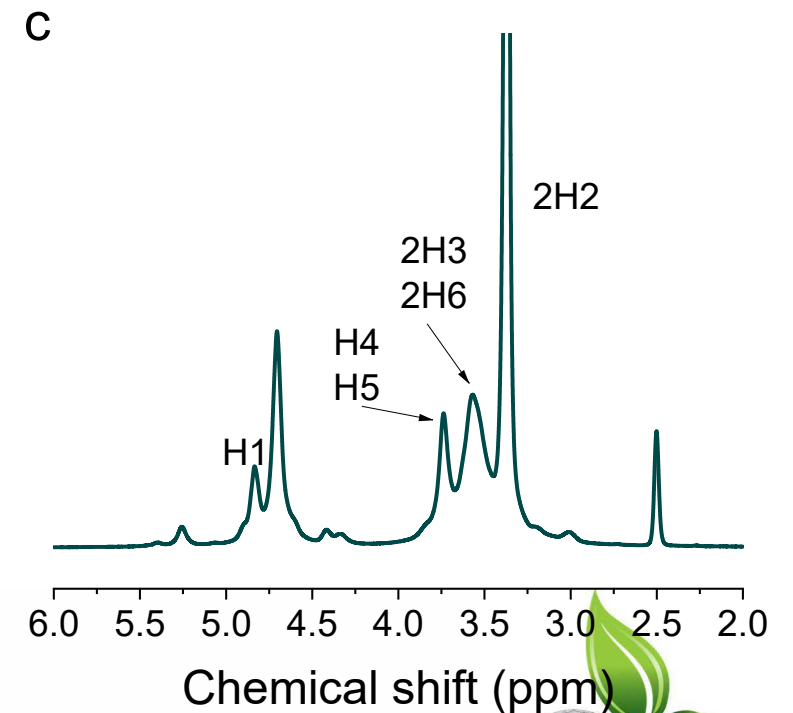
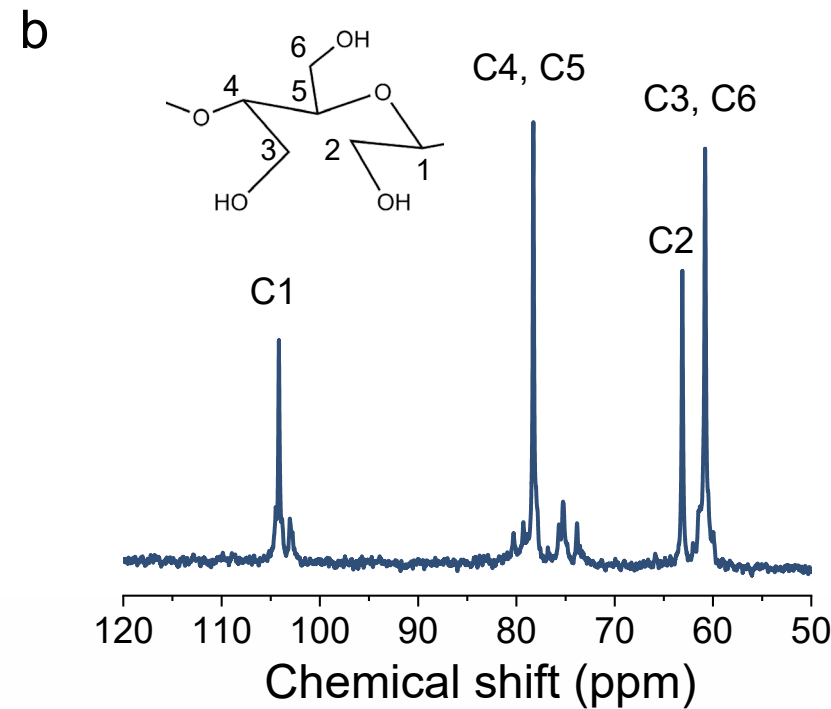
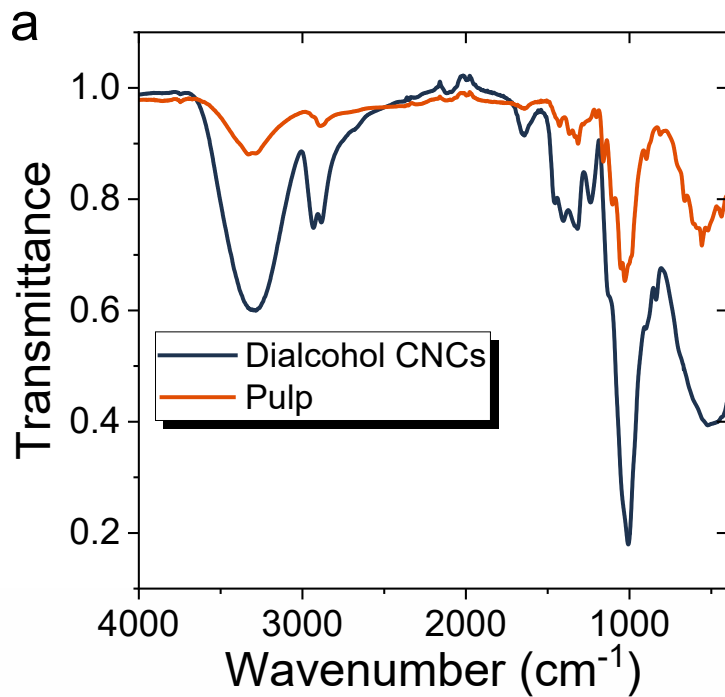
CNCs with high dispersity in water were successfully fabricated through periodate oxidization and following reduction.



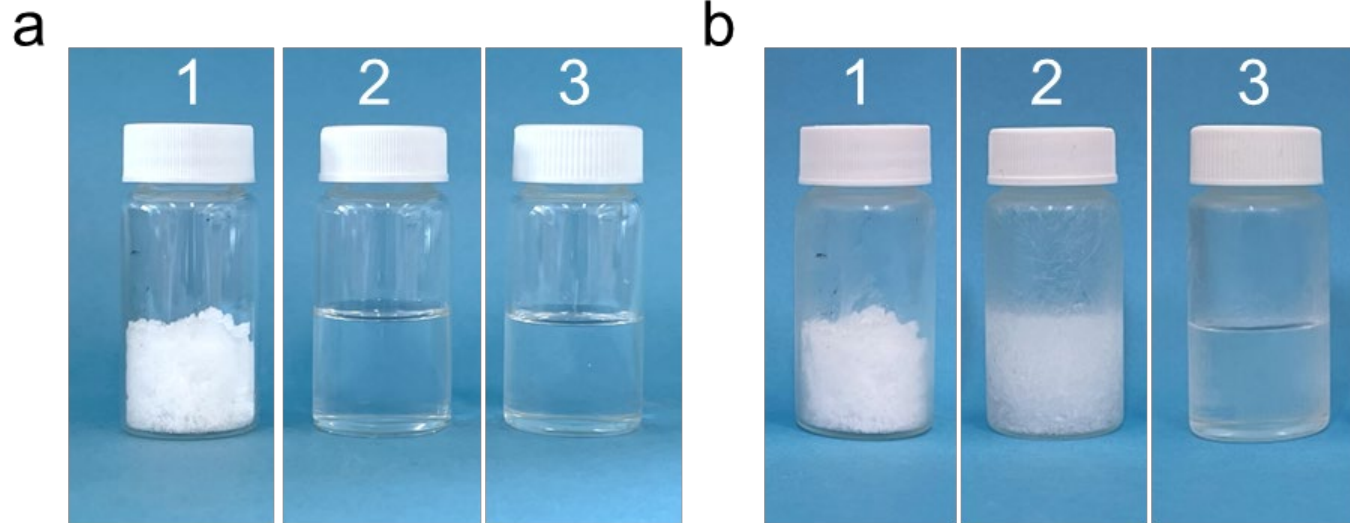
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Direct Mag: 49000x
AHT Camera System



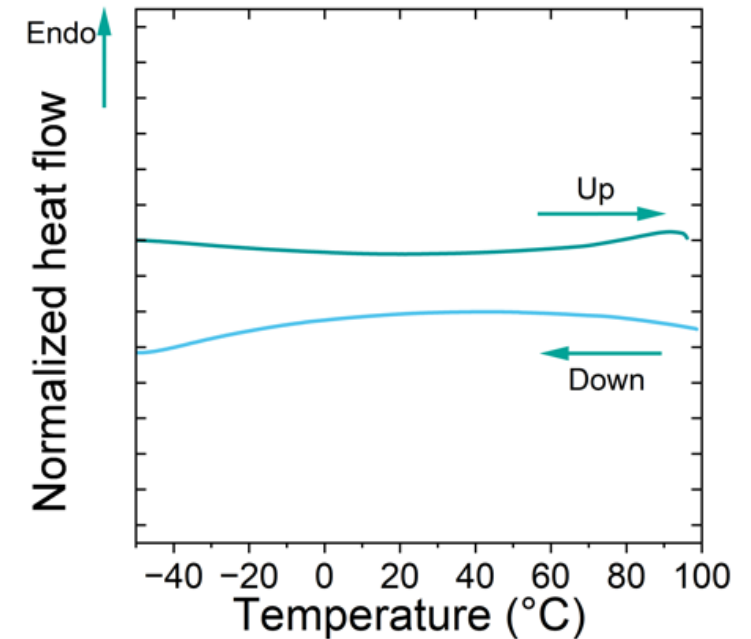
Successful preparation of Dialcohol CNCs



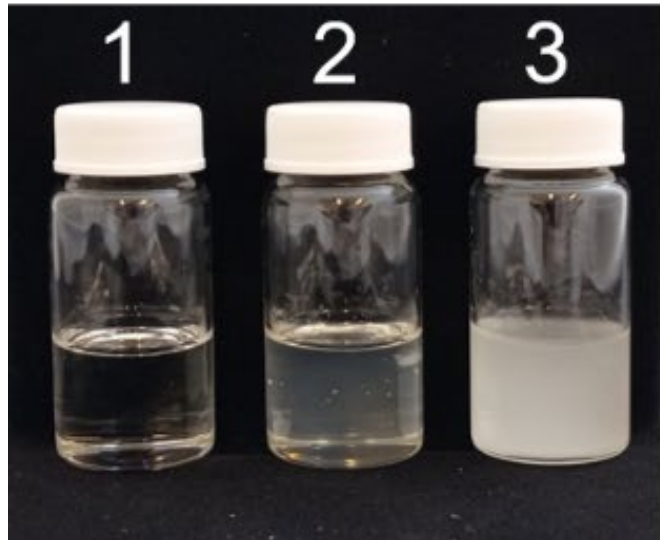
Formation of Polymerizable deep eutectic solvent



1: ChCl, 2: AA, 3: PDES



Dispersion of dialcohol CNCs



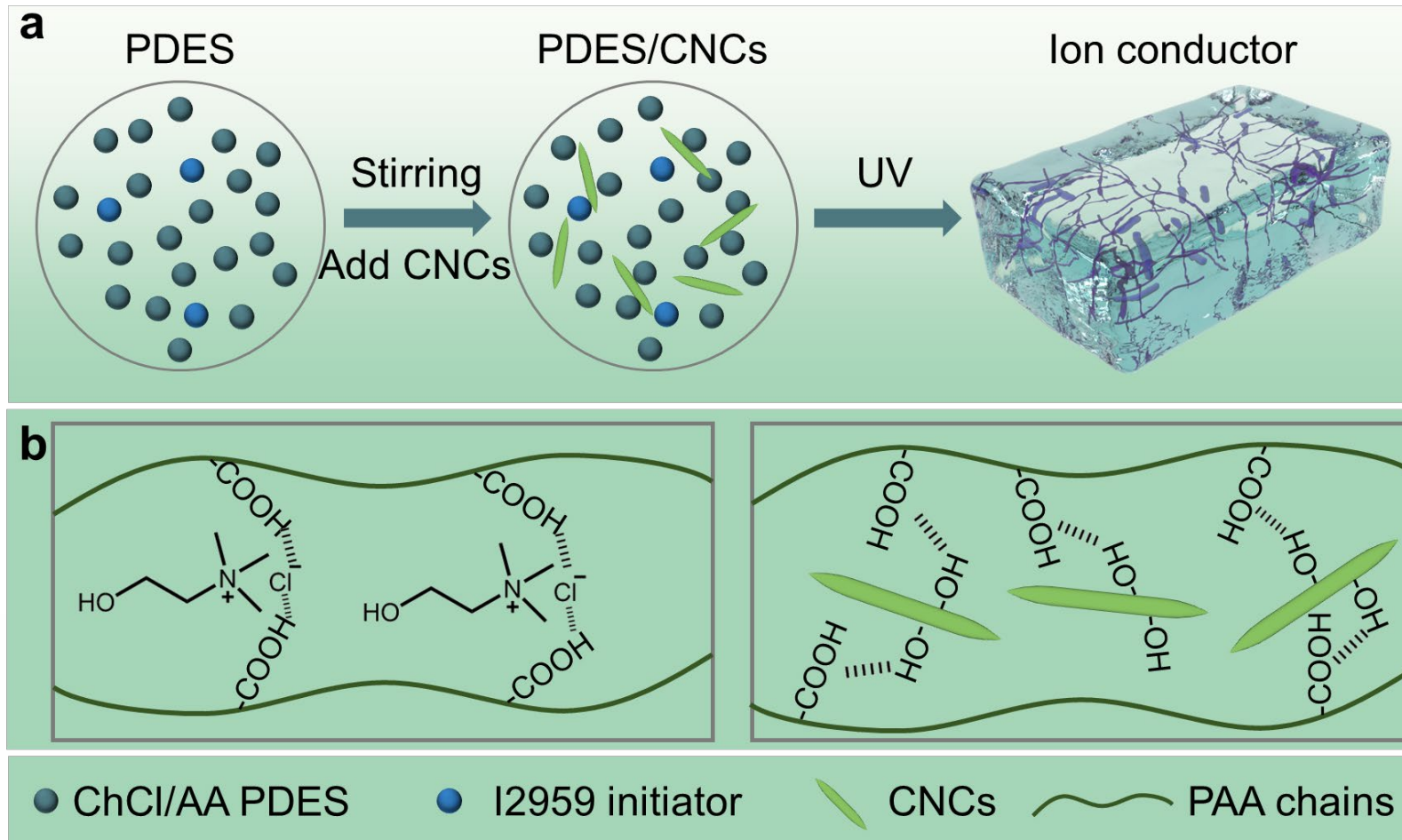
1: PDES

2: PDES/DCNCs (dialcohol CNCs)

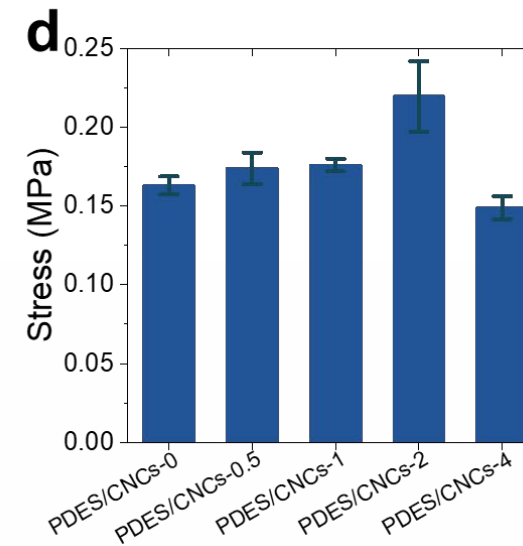
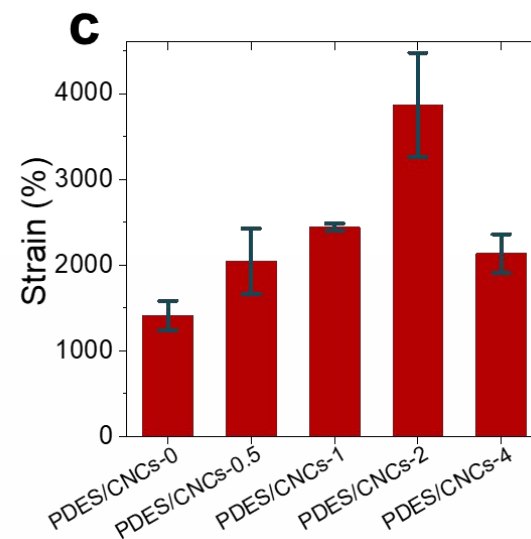
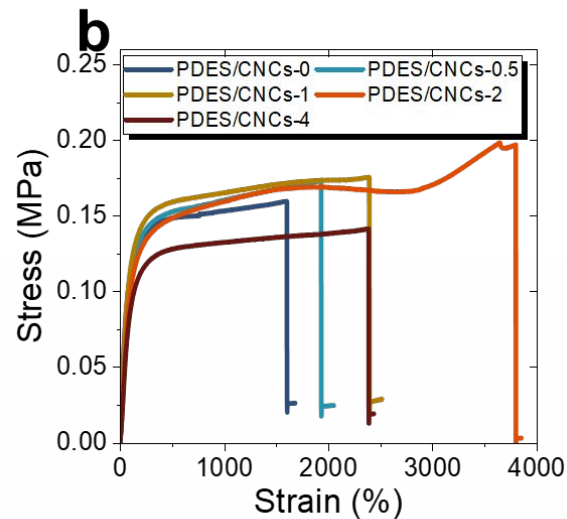
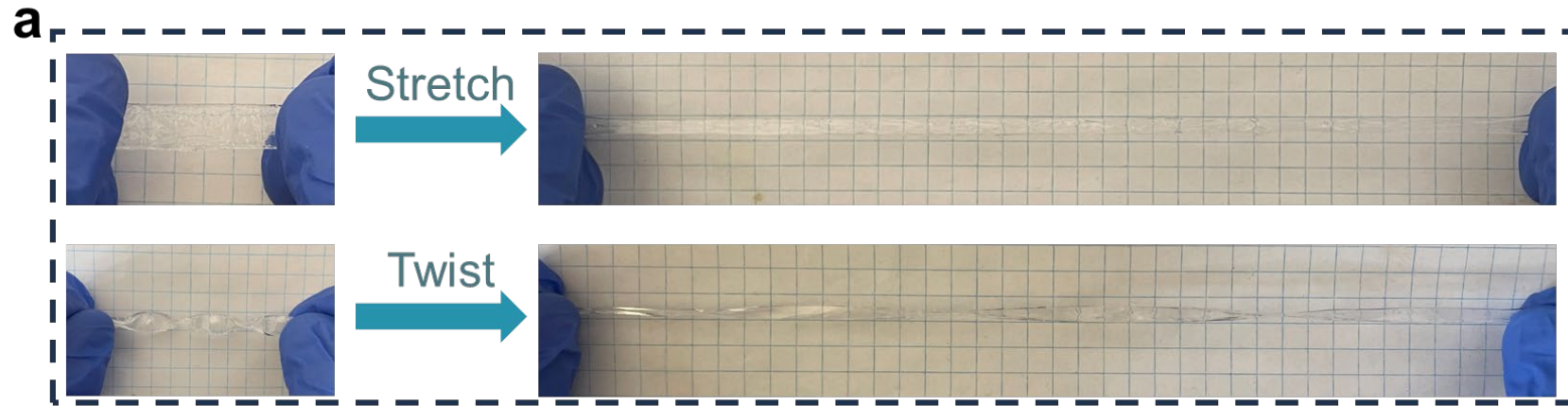
3: PDES/CNCs (commercial CNCs)



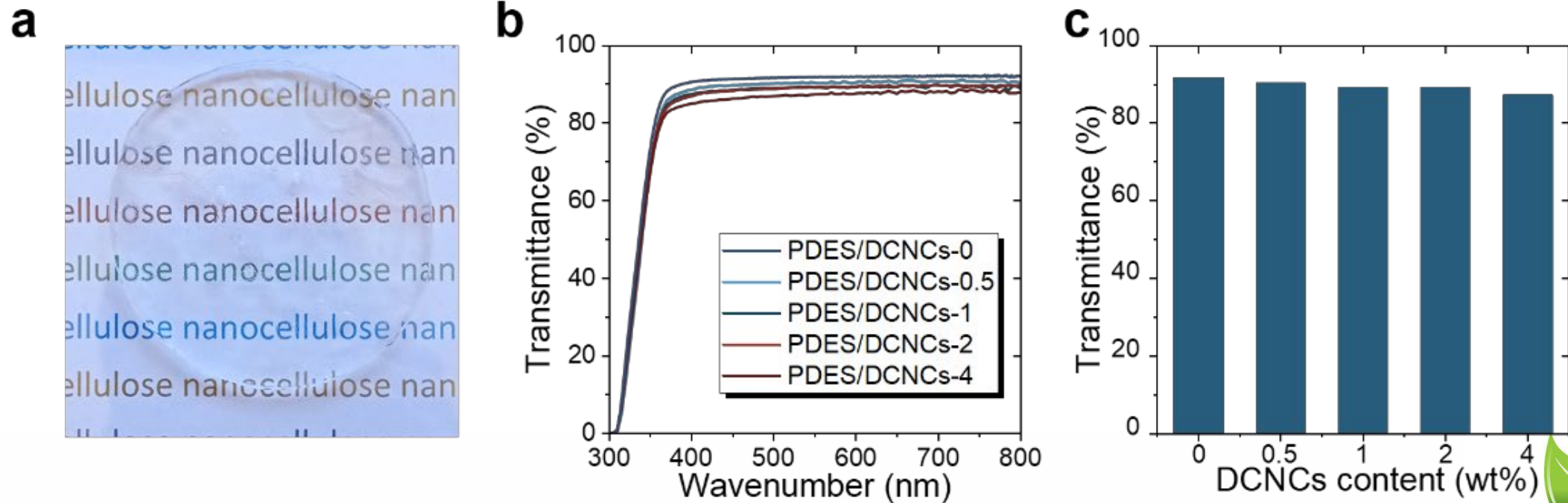
Design route of PDES/CNCs ion conductors



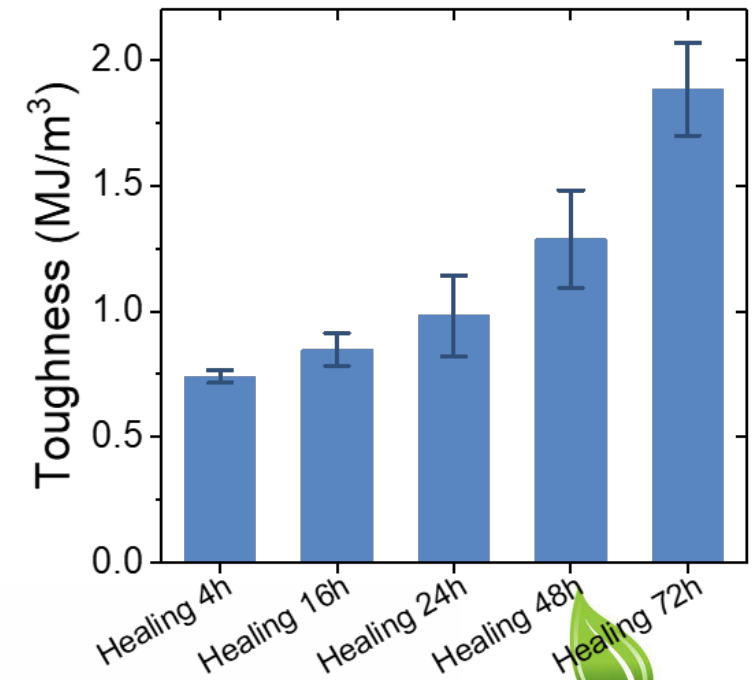
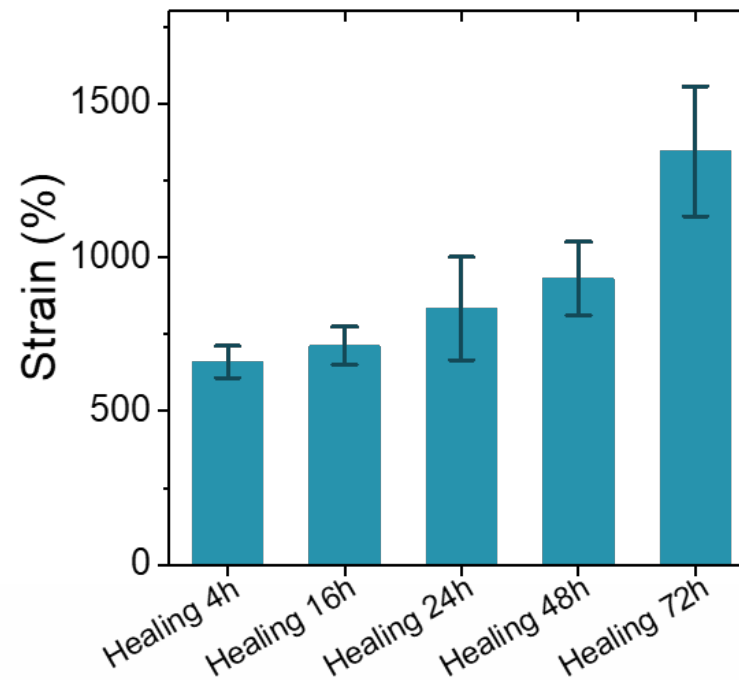
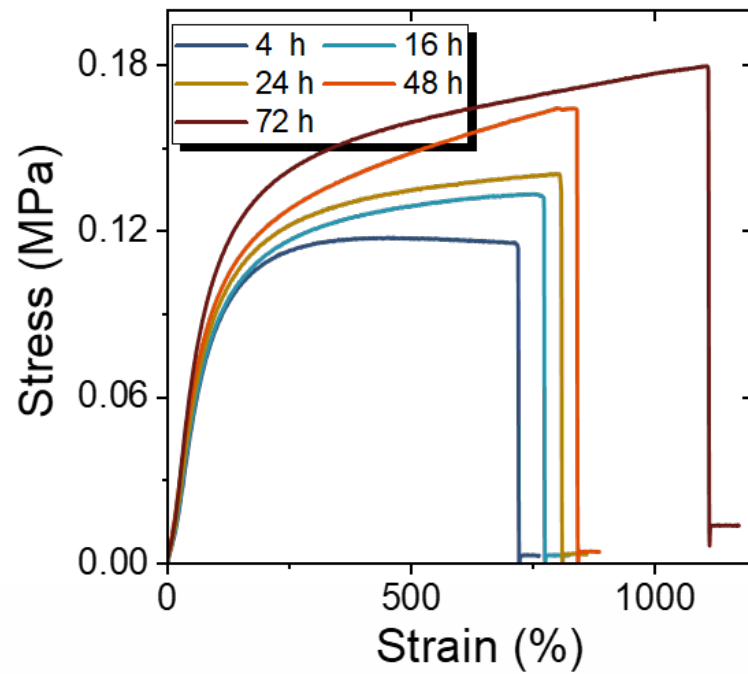
Mechanical properties



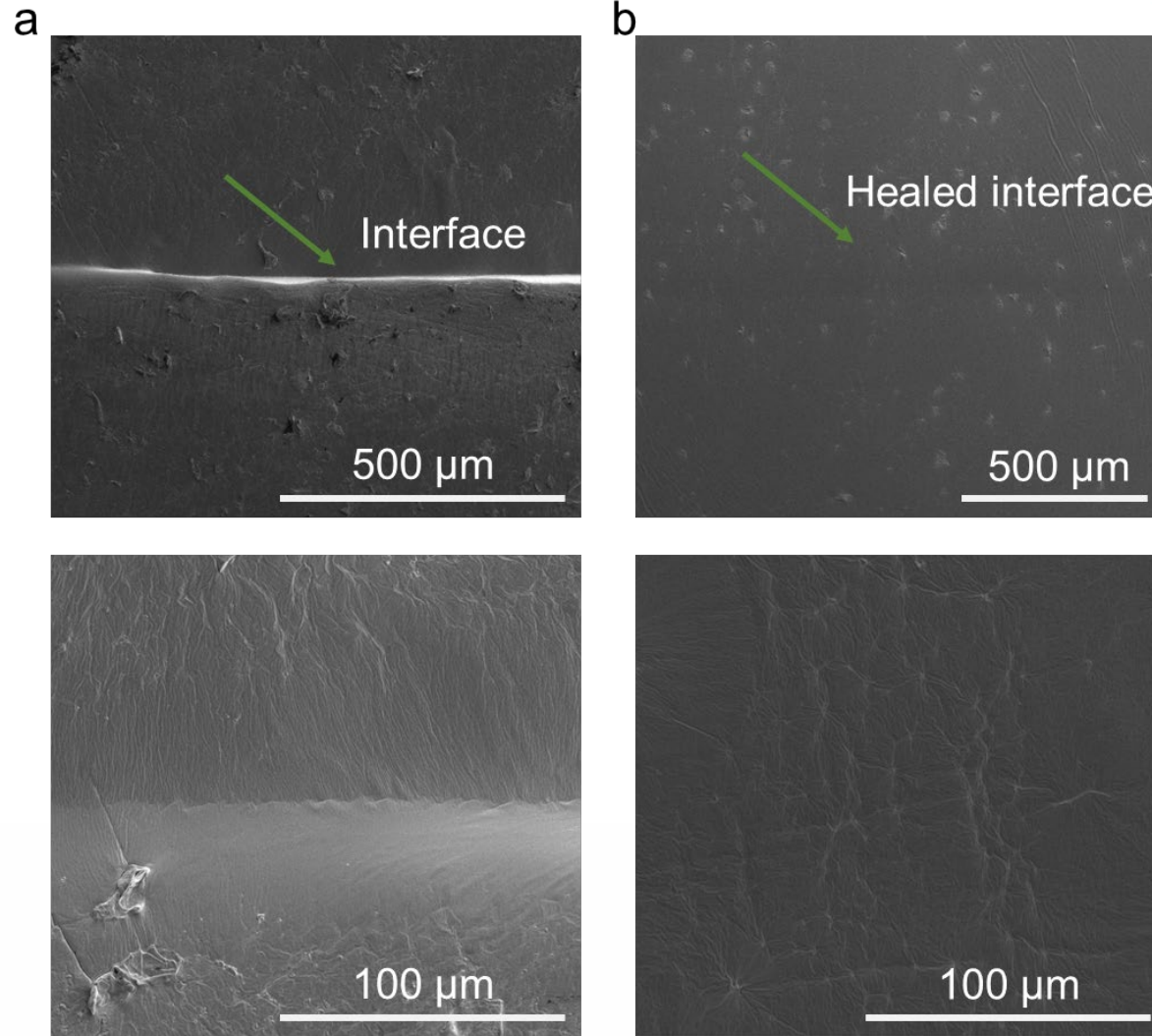
High transparency



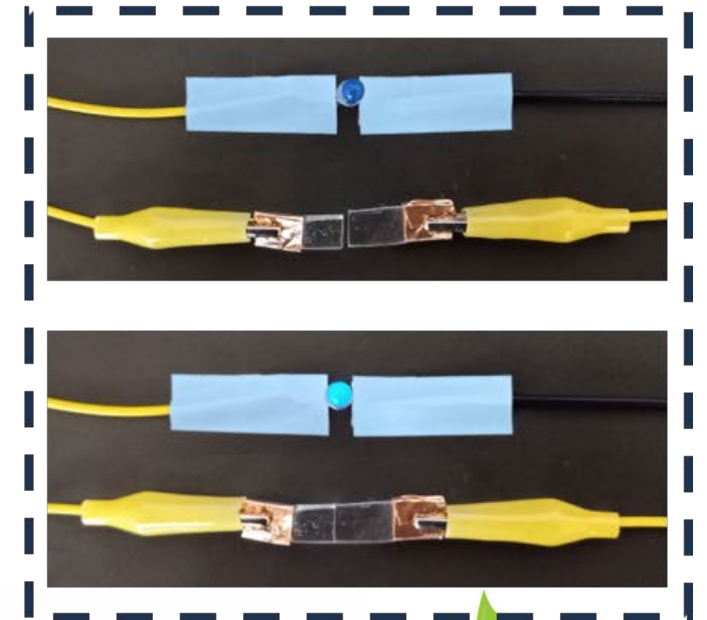
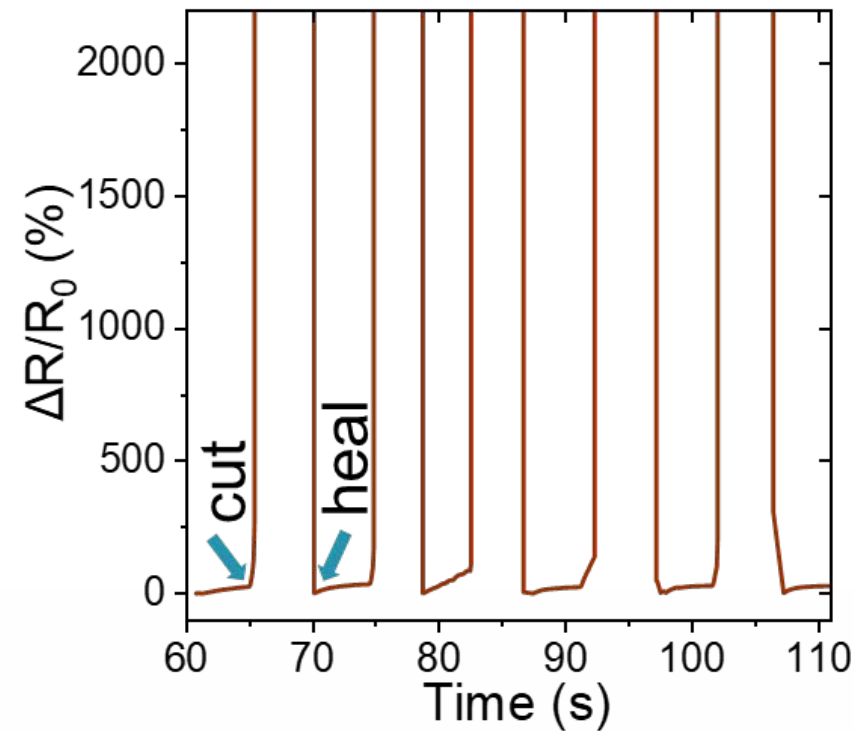
Self-healing ability



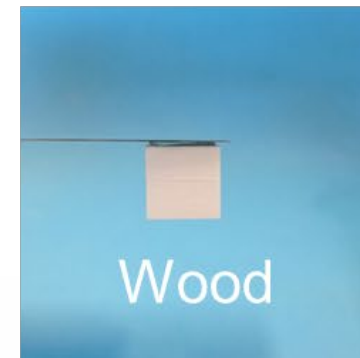
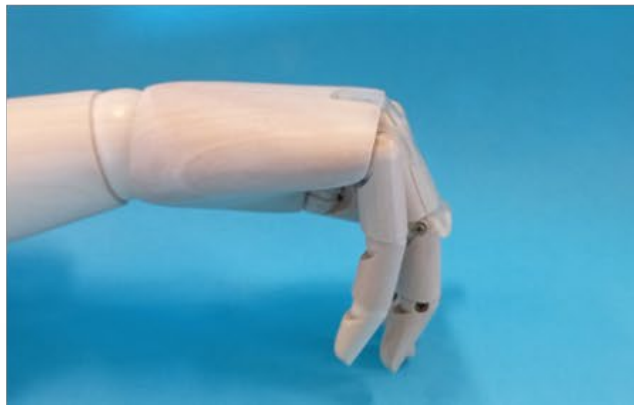
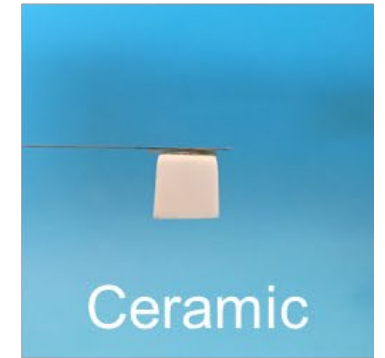
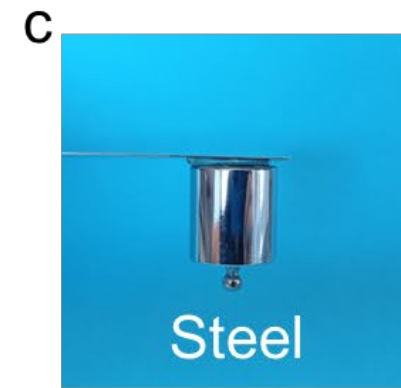
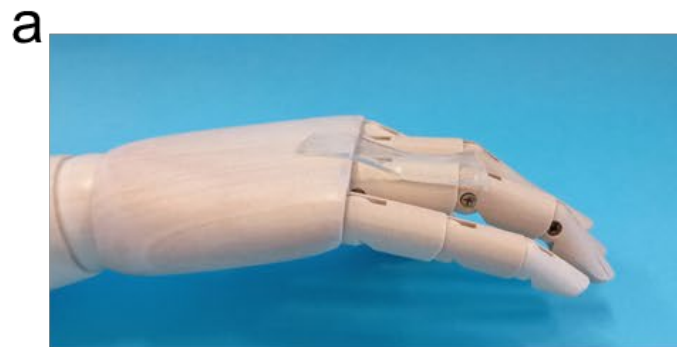
The incision between the healing interface was disappeared after 72 h healing.



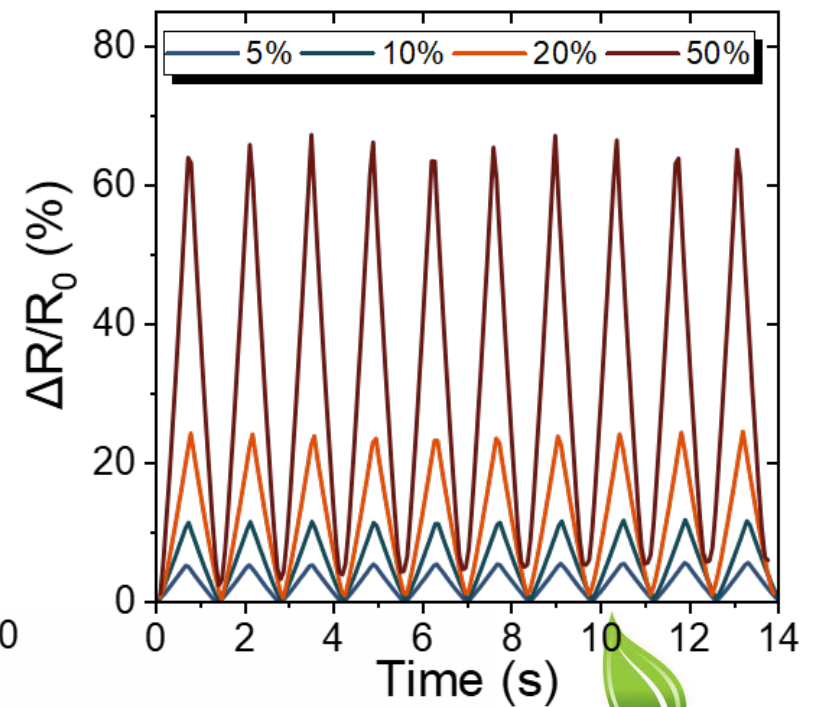
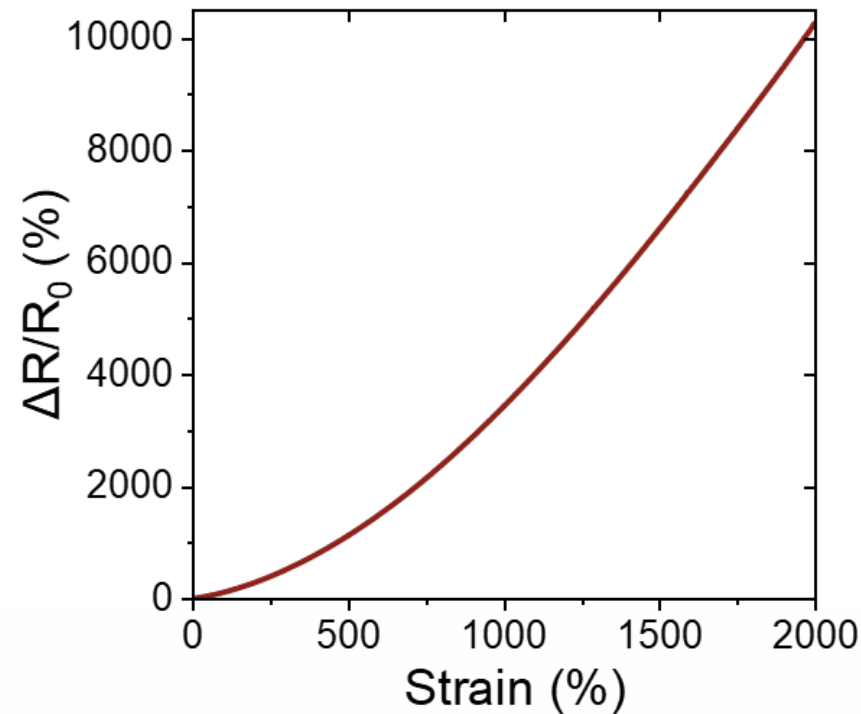
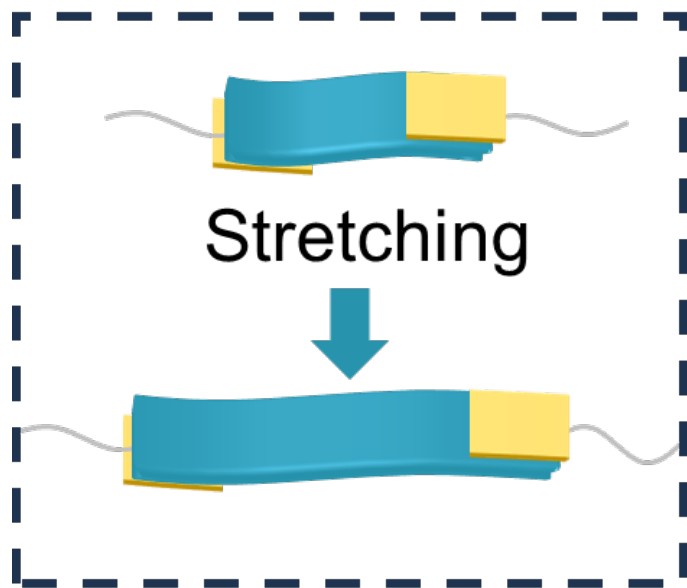
Electrical properties can also be healed in real time.



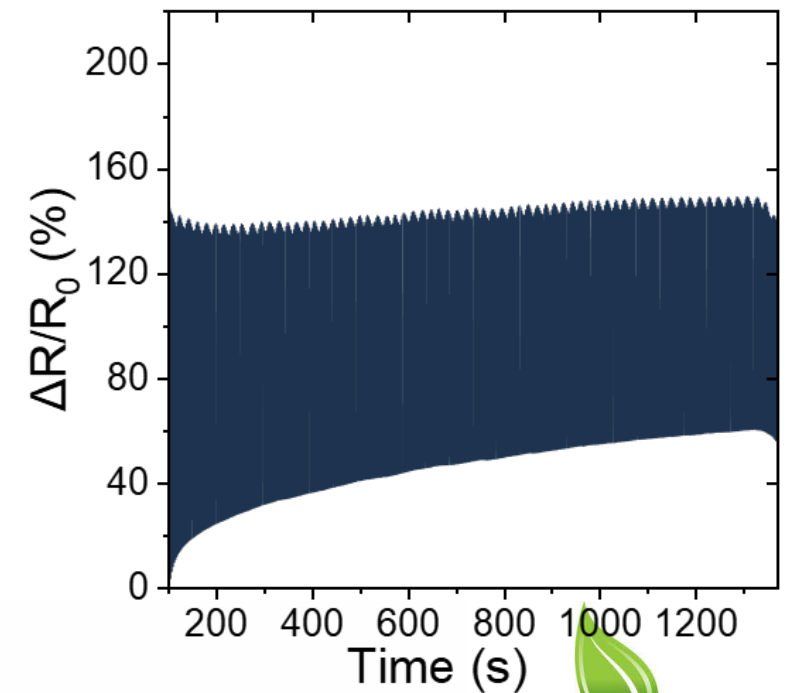
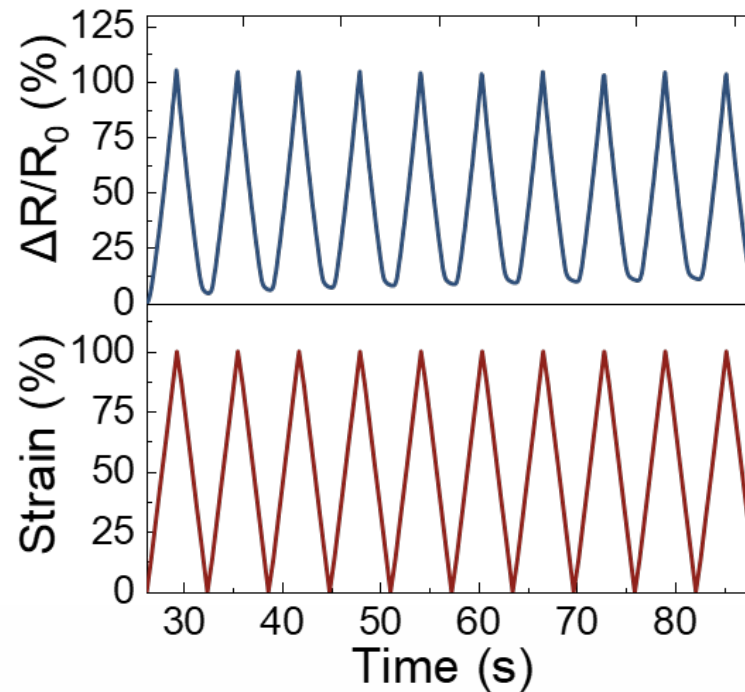
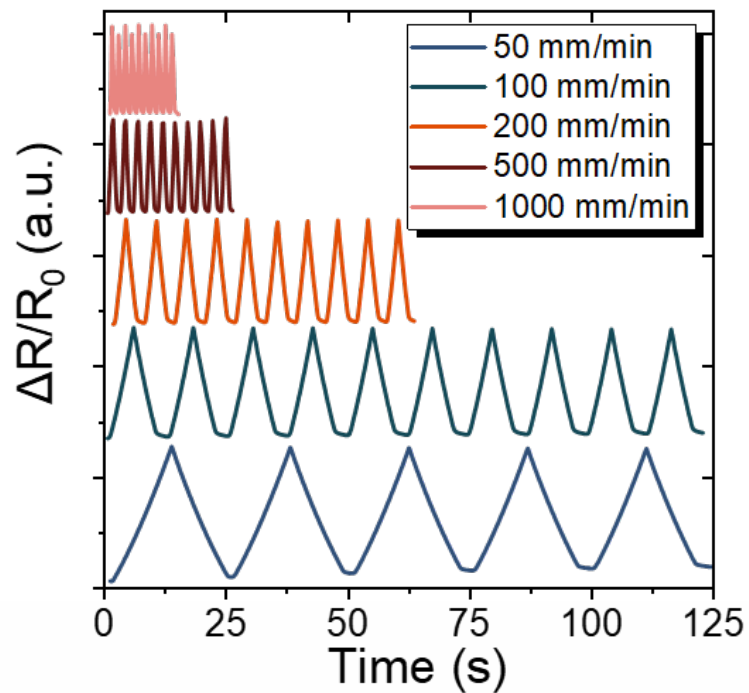
Showing adhesiveness towards various surfaces



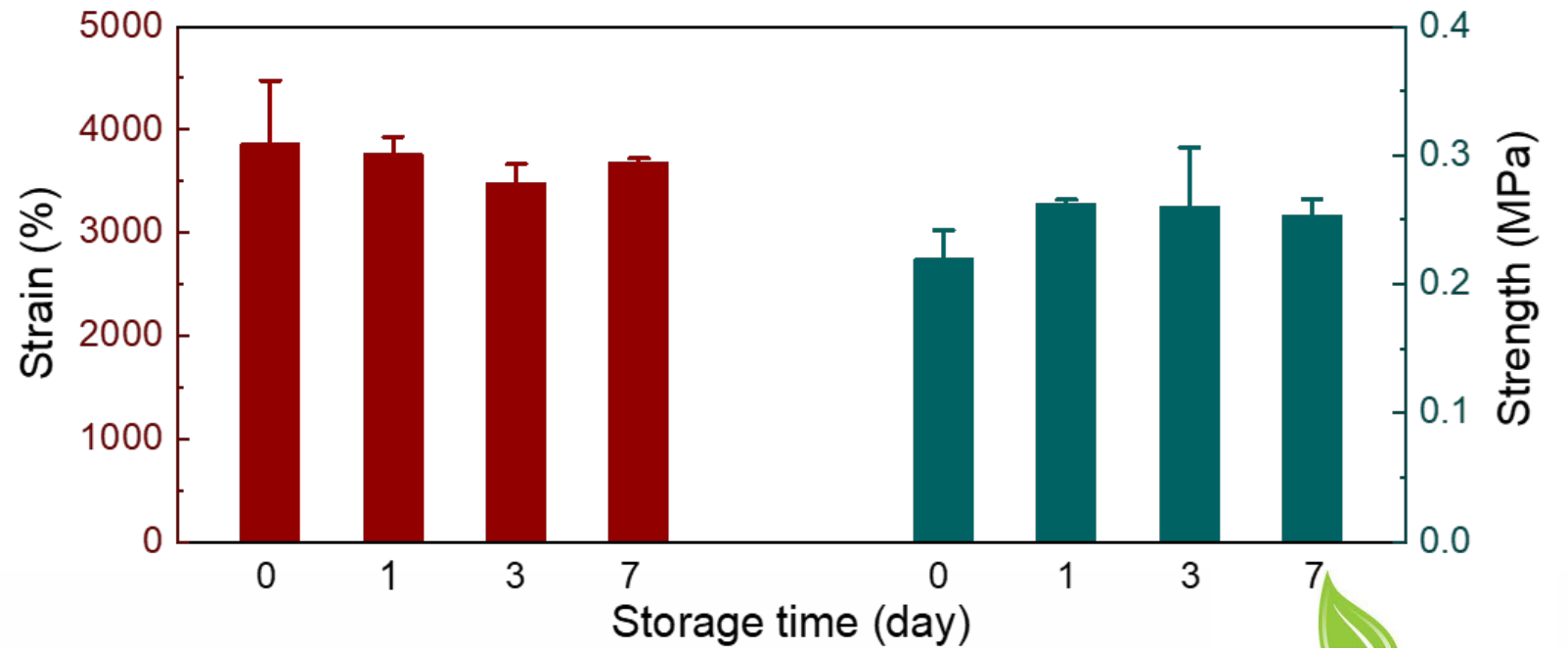
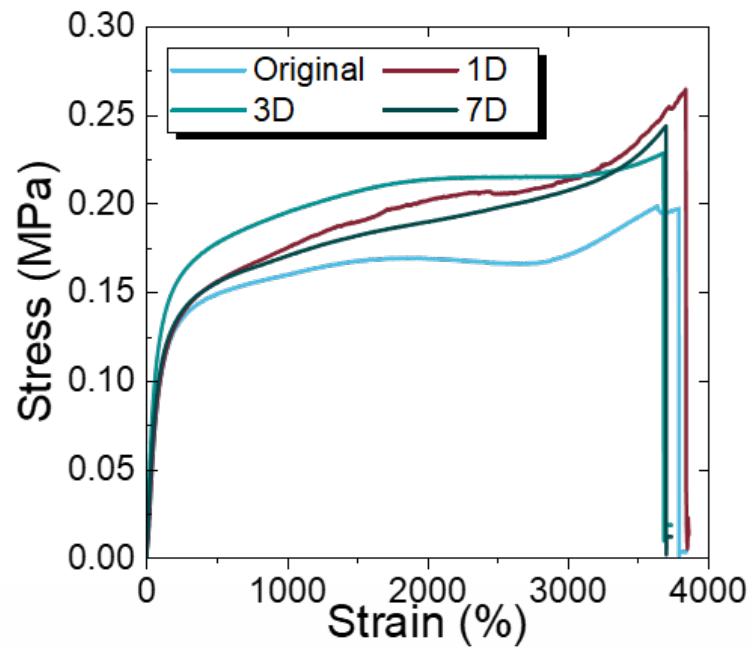
Showing excellent strain sensitivity



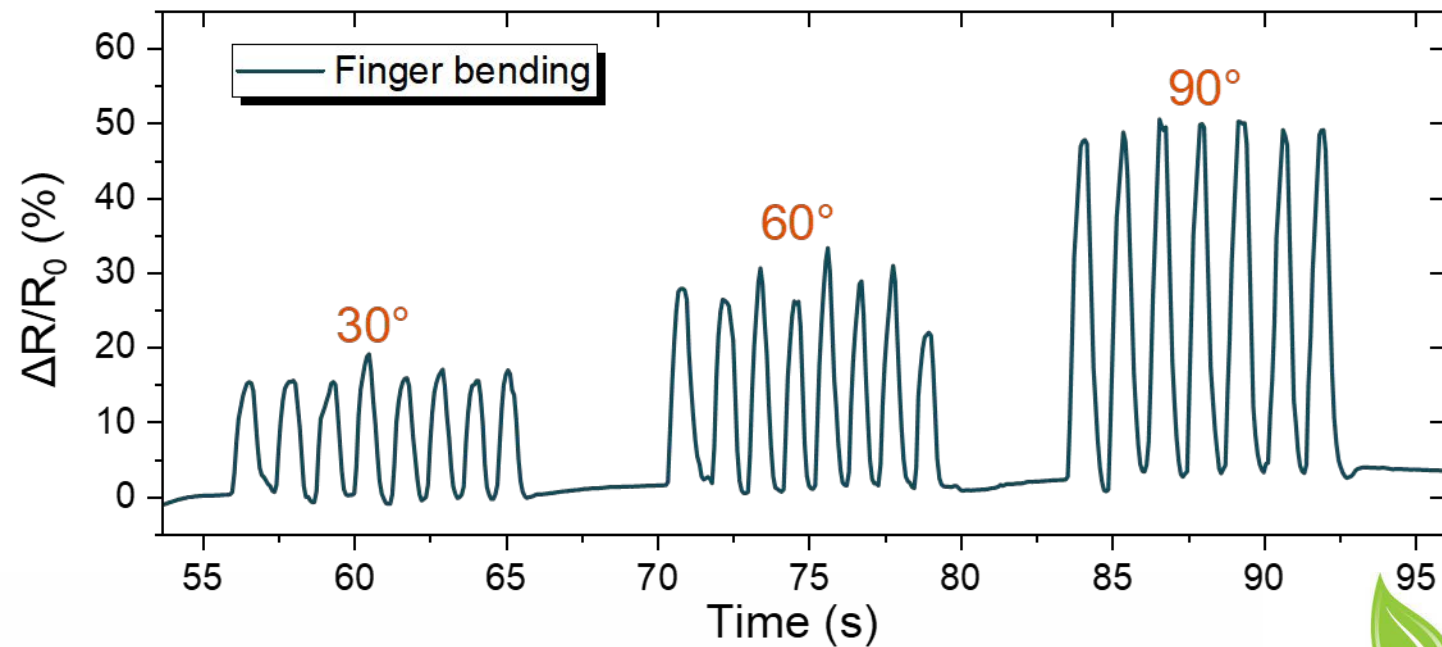
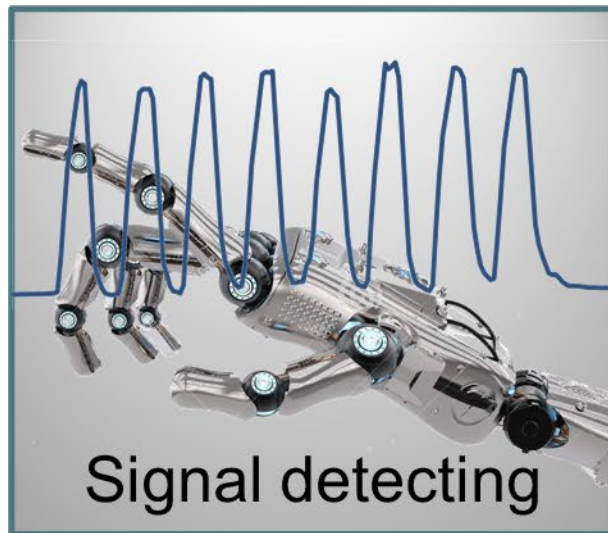
The ion conductor also display stability with fast response.



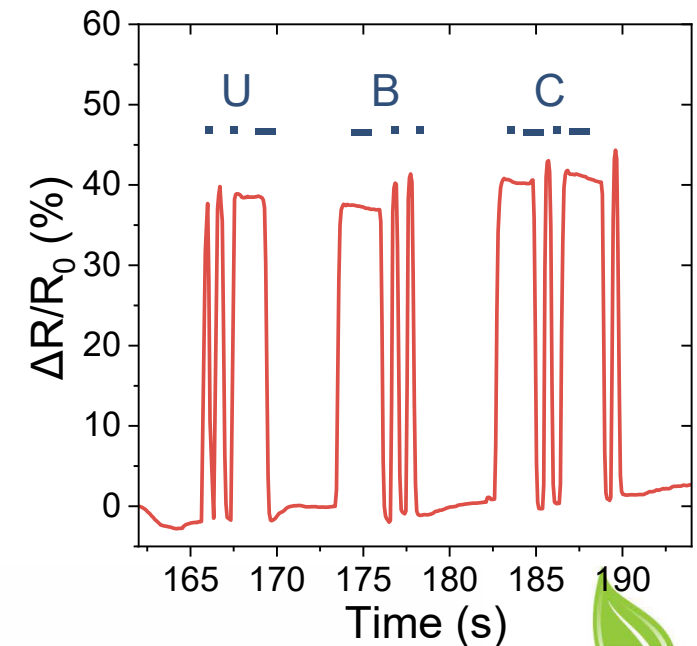
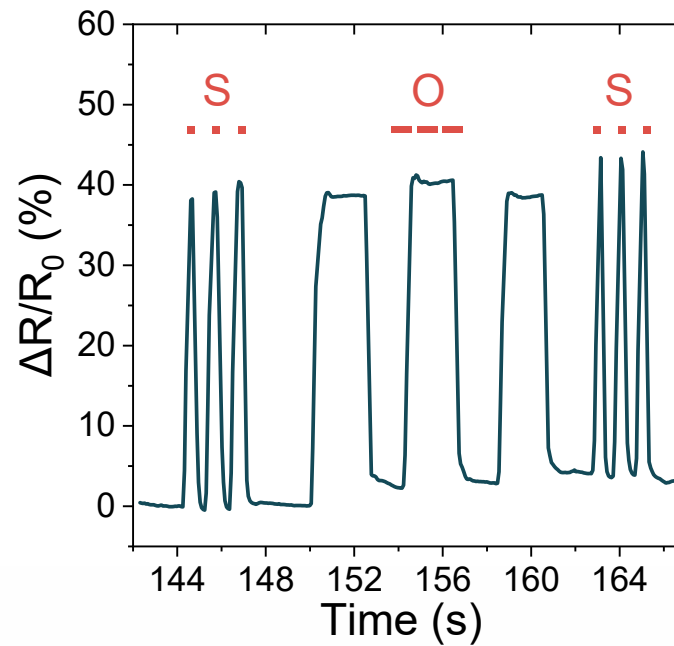
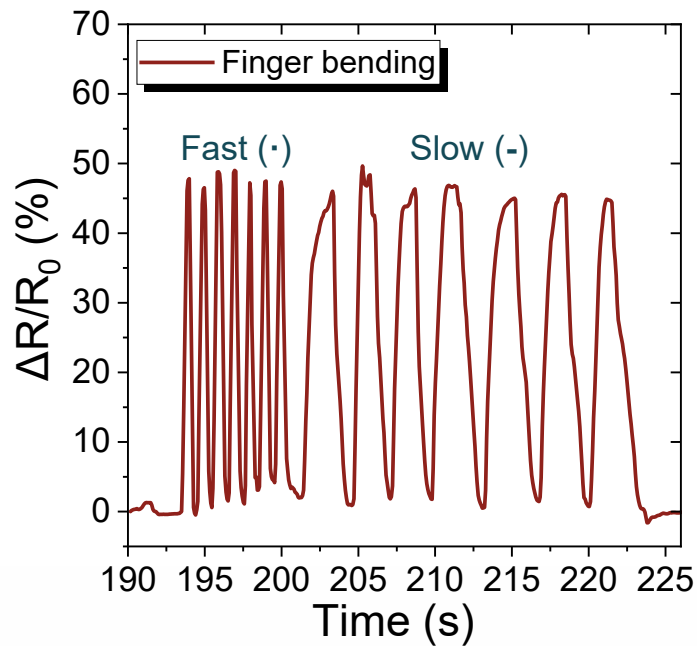
Long-term stability



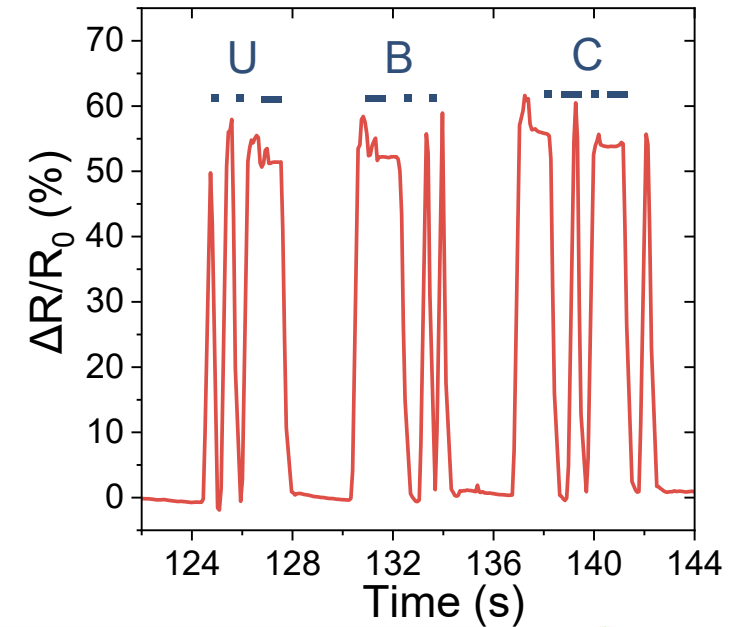
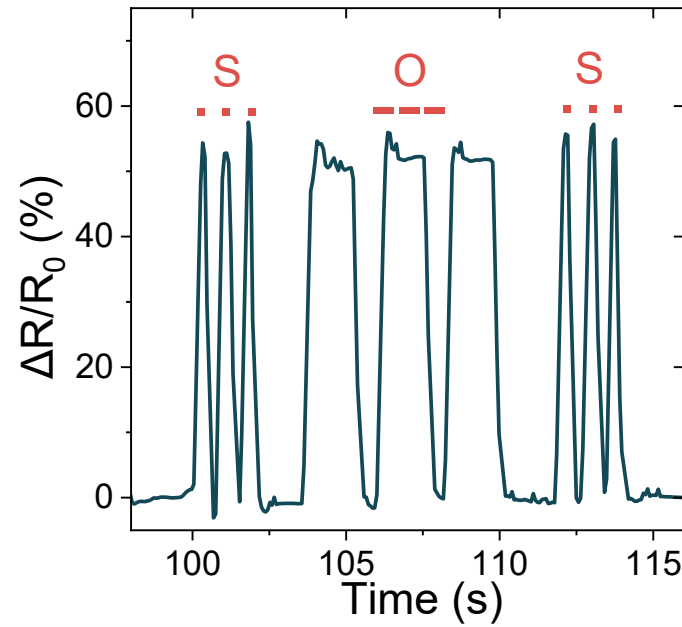
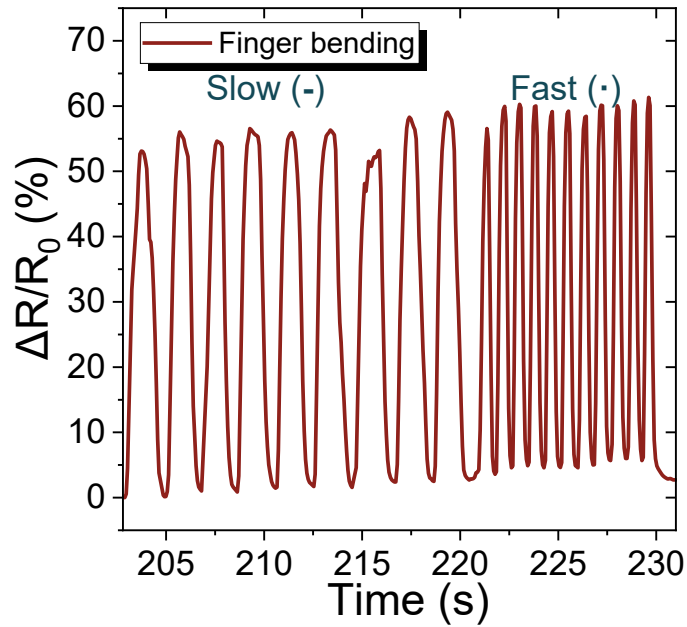
Applications as strain sensors



Applications as strain sensors for signal transmitting



The ion conductor maintain functionality after healing.



International Conference on Nanotechnology for Renewable Materials

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Sustainable Functional
Biomaterials Lab



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