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Water-Based Conductive Nanocellulosic Platform for Flexible Energy Storage

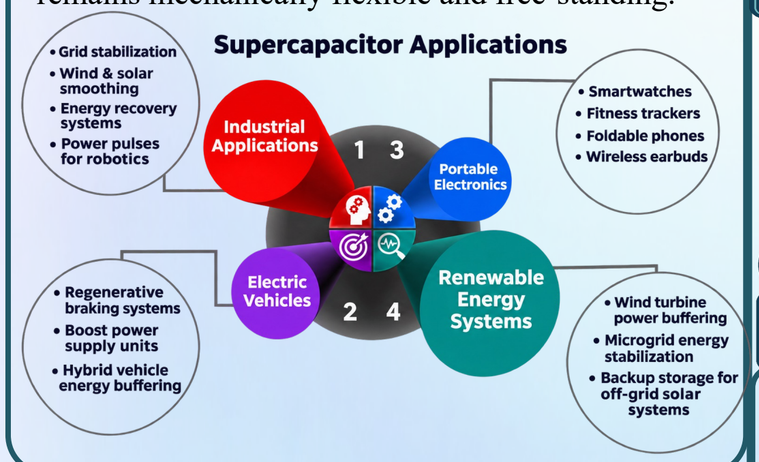
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1 Introduction & Objectives

Conventional metallic current collectors are rigid, costly, and incompatible with roll-to-roll manufacturing. CNF nanopaper — a self-standing film of entangled cellulose nanofibres — offers a renewable, flexible alternative, but its native sheet resistance exceeds 10^7 Ω/sq, making it electrically useless as-is.

We address this by spin-coating a **water-based carbon ink** directly onto CNF nanopaper. With optimised deposition parameters, resistance drops to **~300 Ω** — a ~97% reduction — while the substrate remains mechanically flexible and free-standing.



2 Methodology

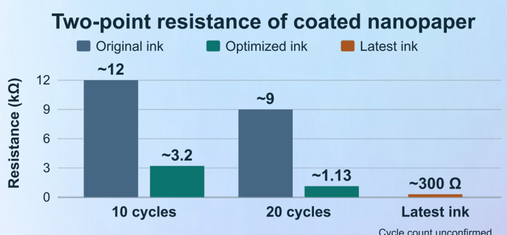
1 Ink Synthesis
Prepared a water-based conductive ink by dispersing carbon nanotubes and carbon black.

2 Spin Coating
Applied the conductive ink to nanopaper by spin coating to form a conductive layer.

3 Characterisation
Assessed ink dispersion, coating morphology and chemistry, and electrical resistance.

4 PANI Polymerisation
Grow polyaniline on the conductive nanopaper as the active layer for pseudocapacitive energy storage.

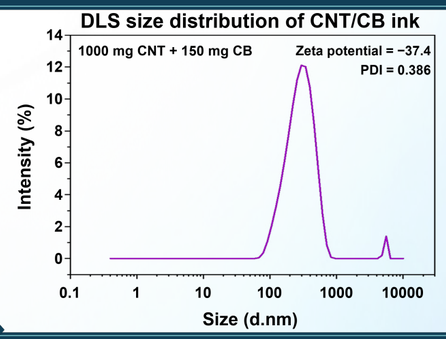
4 Conclusion



The latest ink brought two-point resistance to ~300 Ω, ~97% below the original 20-cycle result, supporting further development of coated nanopaper for flexible supercapacitor electrodes.

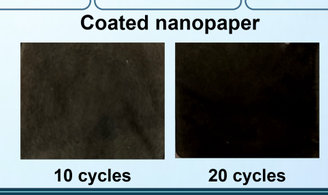
3 Results & Discussion

01 Ink Dispersion

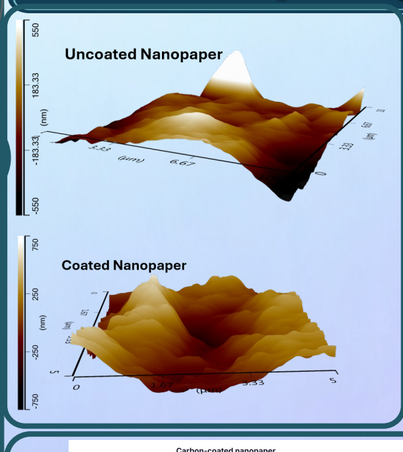


02 Spin Coating

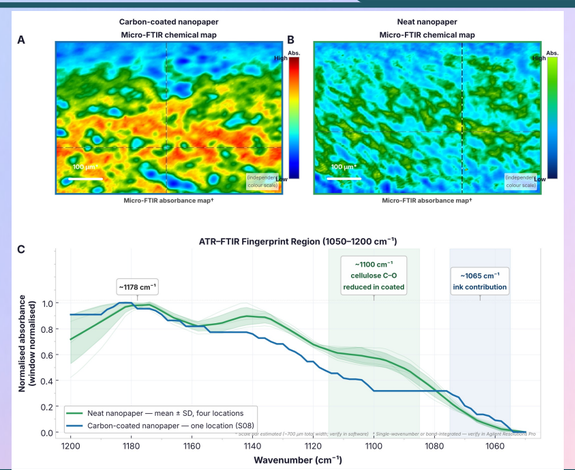
1500 rpm	30 s	150 µL
Spin speed	Per cycle	Ink / cycle



03 Surface Morphology & Chemistry



AFM surface topography. The 3D height maps show uncoated nanopaper (top) and carbon-coated nanopaper (bottom). The coated area shows a broad depression bordered by raised regions.



Micro-FTIR maps (A–B, LNLS Sirius, Brazil) and normalised fingerprint spectra (C, 1050–1200 cm^{-1}) of neat and carbon-coated nanopaper. Suppression at ~1100 cm^{-1} (cellulose C–O) and a new band at ~1065 cm^{-1} confirm conformal ink coating.

5 Acknowledgemts

We thank Tangho Green Canada for providing nanopaper samples.