



Black titania composites for energy-storage applications

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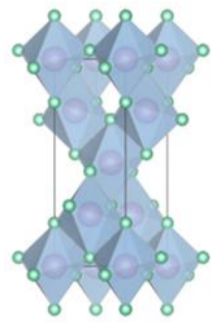
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INTRODUCTION & AIM

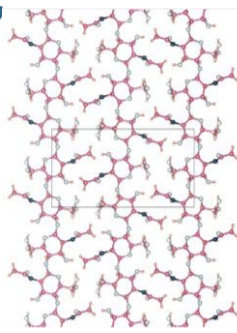
Black titania (BT)

- Black TiO₂
- Structural modifications (Oxygen vacancies/ Ti³⁺ ions) on the surface
- Change in the electronic structure and band gap (1.2-1.7 eV)



Cellulose and Chitin Nanocrystals (CNCs, ChNC)

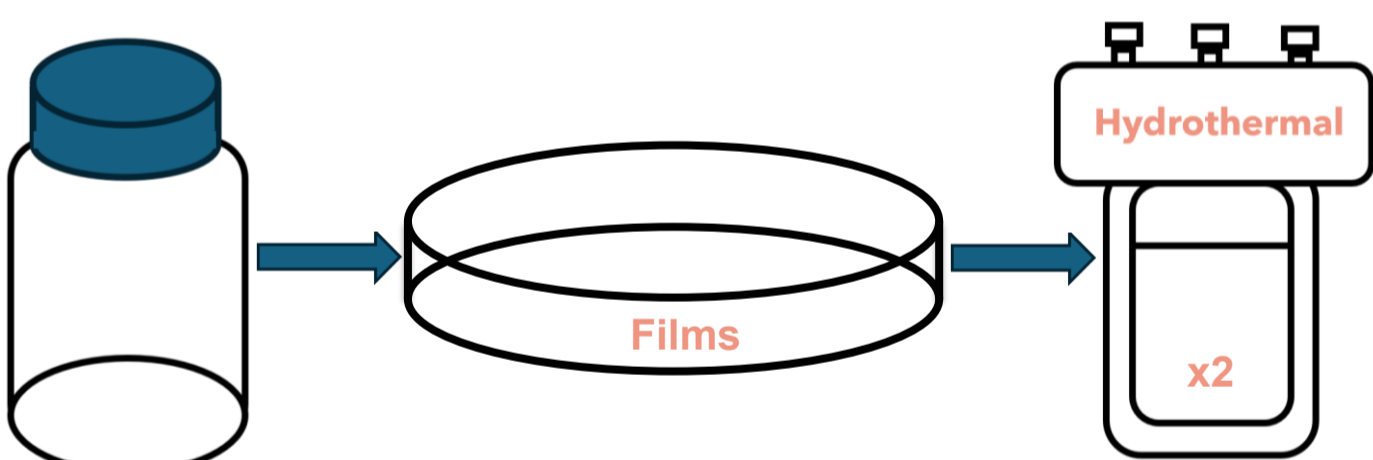
- Cellulose and chitin: First and second most abundant biopolymers on Earth
- Cellulose: Plants
- Chitin: shells of crustaceans and the cell walls of fungi



Composites

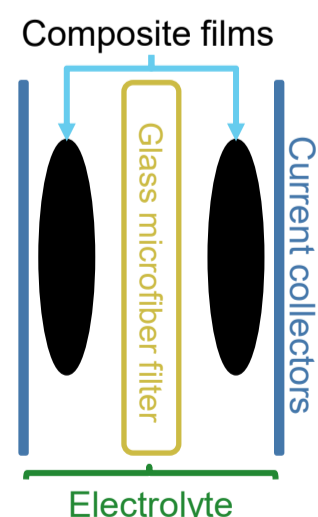
- BT: electronic properties + disordered structure
- CNCs/ChNC: matrix/support, low density, renewability, and biodegradability
- Applications in supercapacitors: **Electrical double-layer capacitors (EDLC)**

METHOD



- Samples**
- Ch3_BT → More ChNC
 - Ch4_BT → More ChNC
- ChNC + glucose**
- Ch3_Gluc_1C → More glucose
 - Ch3_Gluc_1V → More glucose
- ChNC + CNCs**
- Ch3_CNCs → More CNCs
 - Ch3_2_CNCs → More ChNC

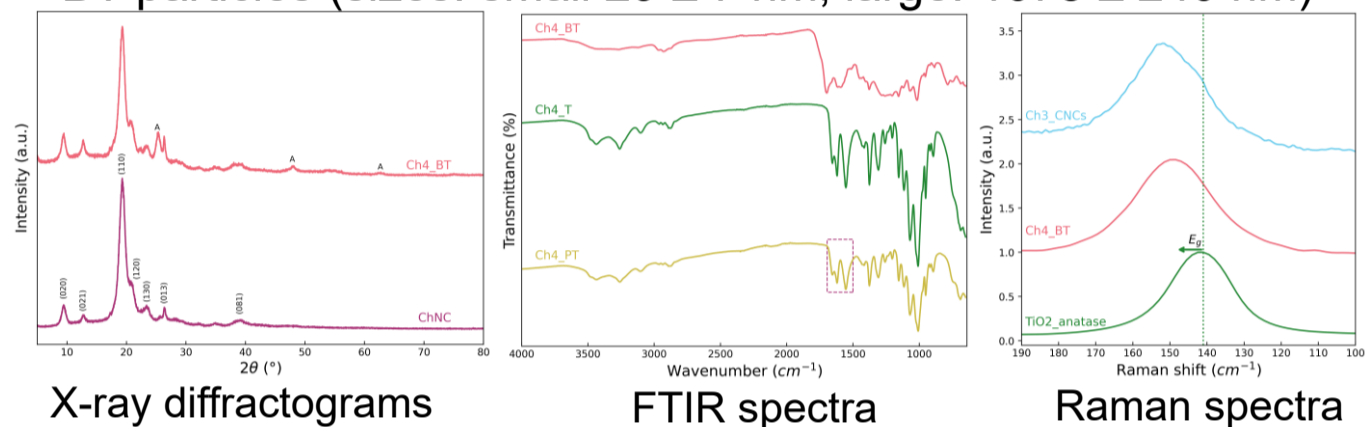
Electrochemical measurements (EDLC):



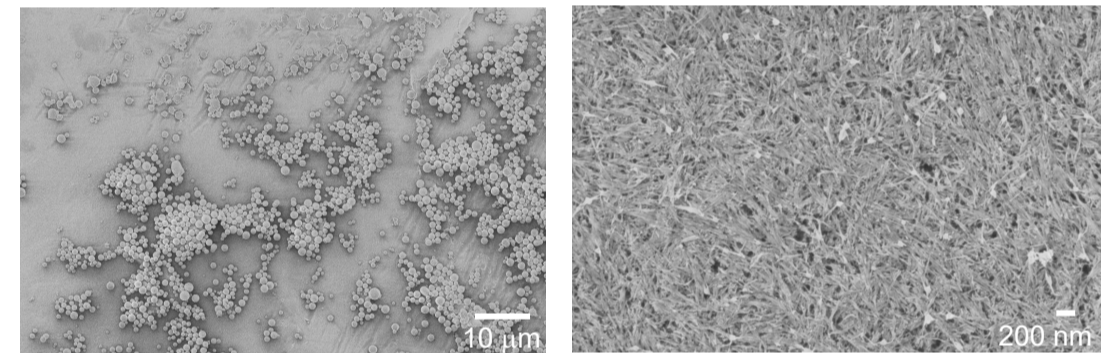
RESULTS & DISCUSSION

Characterization of the composite films

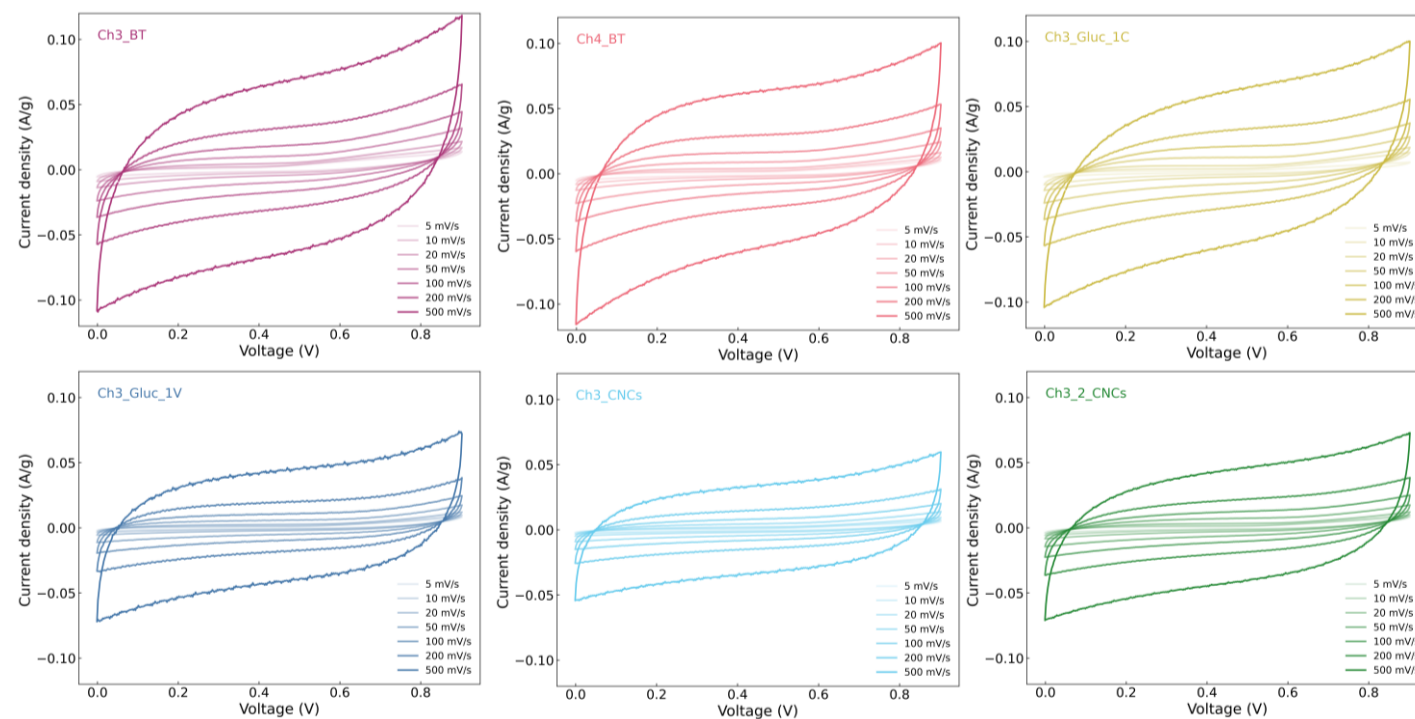
- BT: anatase → 23 nm. ChNC: preferred orientation (110)
- Hydrothermal carbonization of ChNC/CNCs/glucose
- Raman spectroscopy: E_g Raman mode blue-shifted → confirmation of black titania
- All samples - same morphology: ChNC/CNCs/glucose matrix + BT particles (sizes: small 29 ± 7 nm, large: 1078 ± 240 nm)



SEM – representative sample (Ch4_BT)



Cyclic voltammograms: Scan rates



CVs: the squarer and more symmetrical, the better. Improvement with higher scan rates (all samples). Variation with ChNC/CNCs/Glucose precursor content

CONCLUSIONS + FUTURE WORK

- Synthesis, optimization, and characterization of black titania and biopolymers composite films for energy-storage applications
- Confirmation of black titania and carbonization of biopolymer source. Similar morphology for all of the samples
- Supercapacitors applications. Better performance with higher scan rates.
- Future work: explore the effect of different electrolytes

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Acknowledgments

- Prof. Mark MacLachlan
- Ben Herring (SIF-UBC)
- MacLachlan group (UBC)
- YiTao Xu (UBC)
- Dan Bizzoto (UBC)
- Mario Gonzalez (UBC)
- Derrick Horne (BIF-UBC)