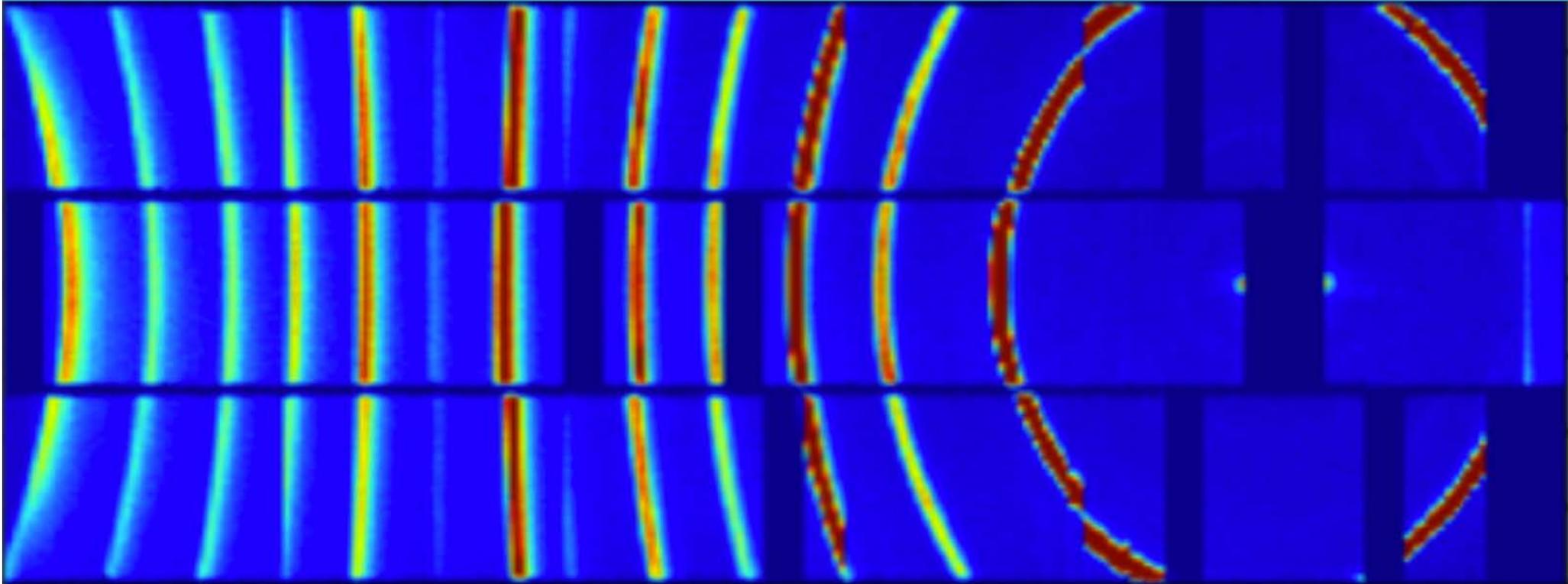


THE PHYSICS OF HOW MATERIALS STORE ENERGY



Hillary Smith

16 November 2018

THE PHYSICS OF HOW MATERIALS STORE ENERGY

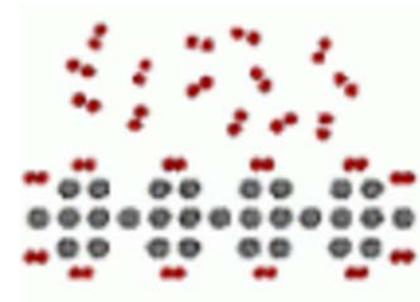
How does the structure of the battery change when lithium is inserted into and extracted from the cathode of a lithium-ion battery?

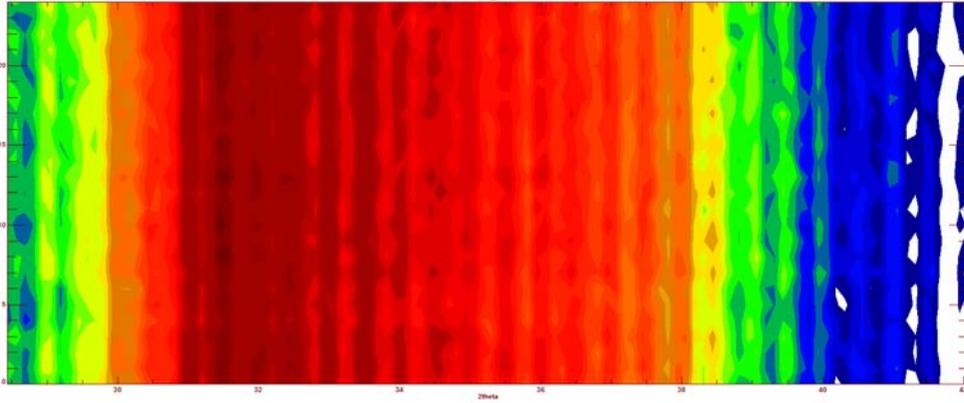
What is the thermal stability of materials for storing hydrogen relate, and how does this relate its adsorptive properties?

What changes occur in local electron dynamics when the battery is charged and discharged?

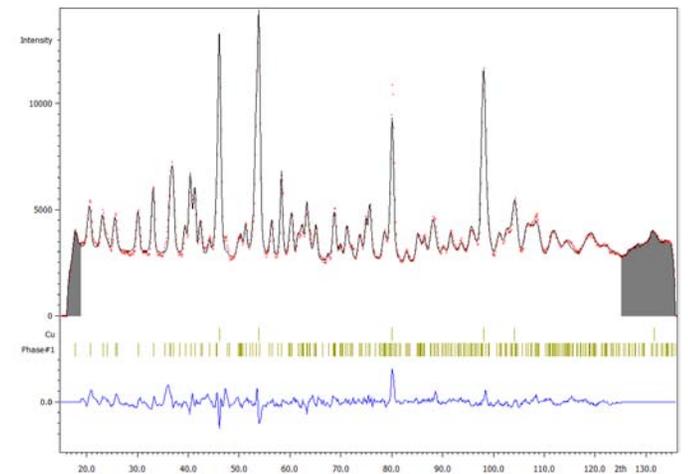
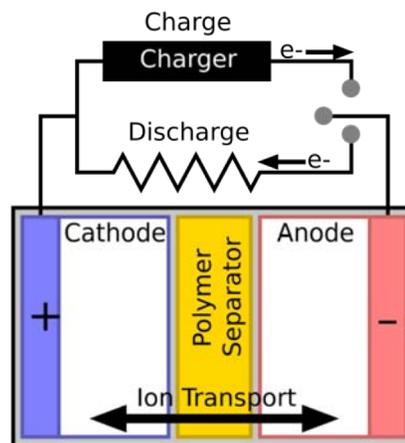
Does the specific heat capacity reveal any thermal behavior that can suggest ways to optimize the adsorption process?

The fundamental physics of a *material* is connected to all of its interesting *properties*





My research makes connections between a material's [thermodynamic, magnetic, structural] properties and its utility for a functional application [like in a battery]



WHY DO WE CARE ABOUT ENERGY STORAGE?

Energy storage is important for stationary power, portable power, and transportation.



Global
Access to
Clean
Energy

The development of higher-capacity battery cathodes will not only enable cheaper portable electronic devices, but can be used in combination with solar cells to store energy in parts of the world without connection to the energy grid.

Sustain-
ability

Understanding how secondary battery systems in hybrid vehicles degrade over time could allow them to be recycled in stationary energy storage applications after they are no longer of use in the vehicle.

Materials are crucial to the development of socially-responsible alternative energy solutions.

SUMMER PROJECT I

Thermal Analysis and Heat Capacity Study of Carbon-based Hydrogen Storage Materials

- What is the thermal stability of materials for storing hydrogen relate, and how does this relate its adsorptive properties?
- Does the specific heat capacity reveal any thermal behavior that can suggest ways to optimize the adsorption process?

SUMMER PROJECT II

Investigation of Olivine NaFePO_4 and Mixed-Metal Fluorides during Operando Electrochemical Cycling

- How does the structure of the battery change when lithium is inserted into and extracted from the cathode of a lithium-ion battery?
- What changes occur in local electron dynamics when the battery is charged and discharged?

SUMMER PROJECT I

HYDROGEN STORAGE MATERIALS

- Analyzing data collected at NIST (National Institute of Standards and Technology) of hydrogen uptake as a function of temperature
- Getting our new calorimetry system working and testing it
- Preparing new materials for characterization

SUMMER PROJECT II

LITHIUM AND SODIUM ION BATTERY MATERIALS

- Analyzing data collected at ANSTO (Australian Nuclear Science and Technology Organisation) of the structure of the battery cathode during operation
- Building our new Mossbauer spectrometer
- Constructing batteries that we will measure with the Mossbauer

WHAT YOUR SUMMER WOULD LOOK LIKE

- My lab is currently under construction- your time will be spent:
 - helping to bring new equipment and tools online
 - analyzing previously acquired data
 - making samples and testing them
- Beyond Summer 2019
 - Possibility for semester or thesis work
 - Possibility to travel to a national lab for experiments
 - Possibility to present results at a national meeting/conference

I'M ALWAYS HAPPY TO TALK ABOUT
THESE EXCITING TOPICS!
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