Nanohybrids for Energy & the Environment

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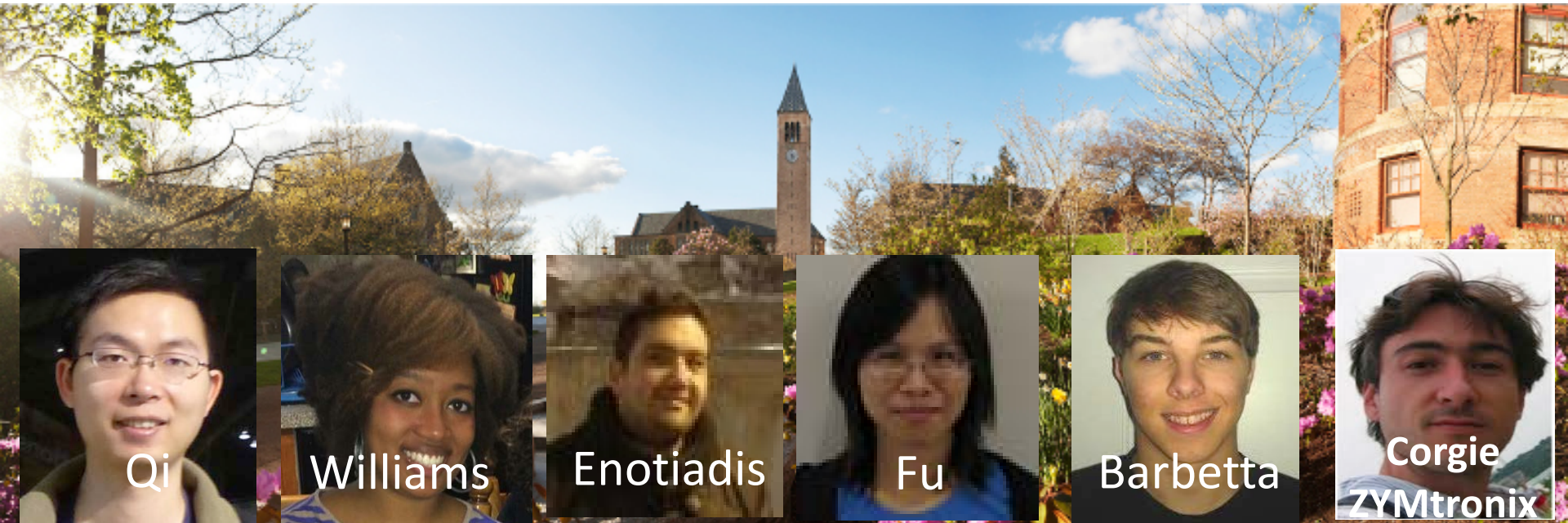
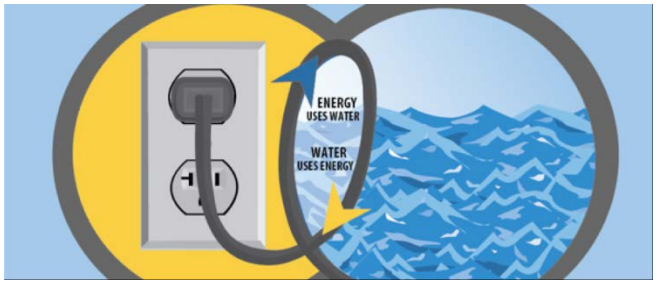


Global Challenges: Technology Driven

- Health
- Energy
- Water
- Environment

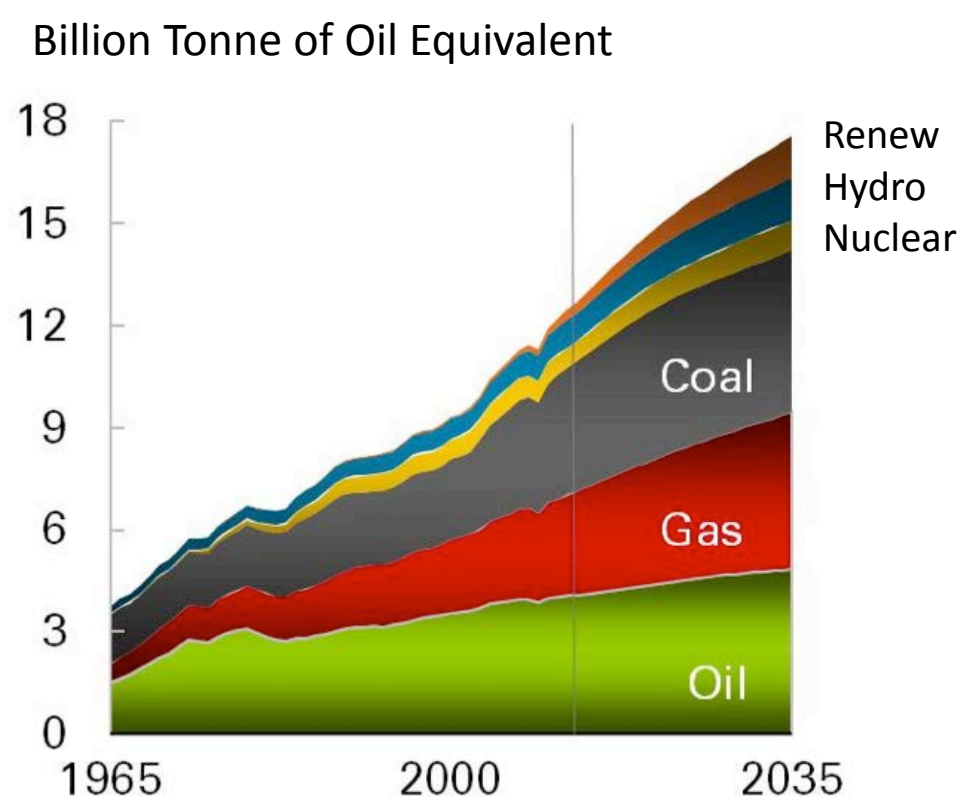
The Energy-Water Nexus

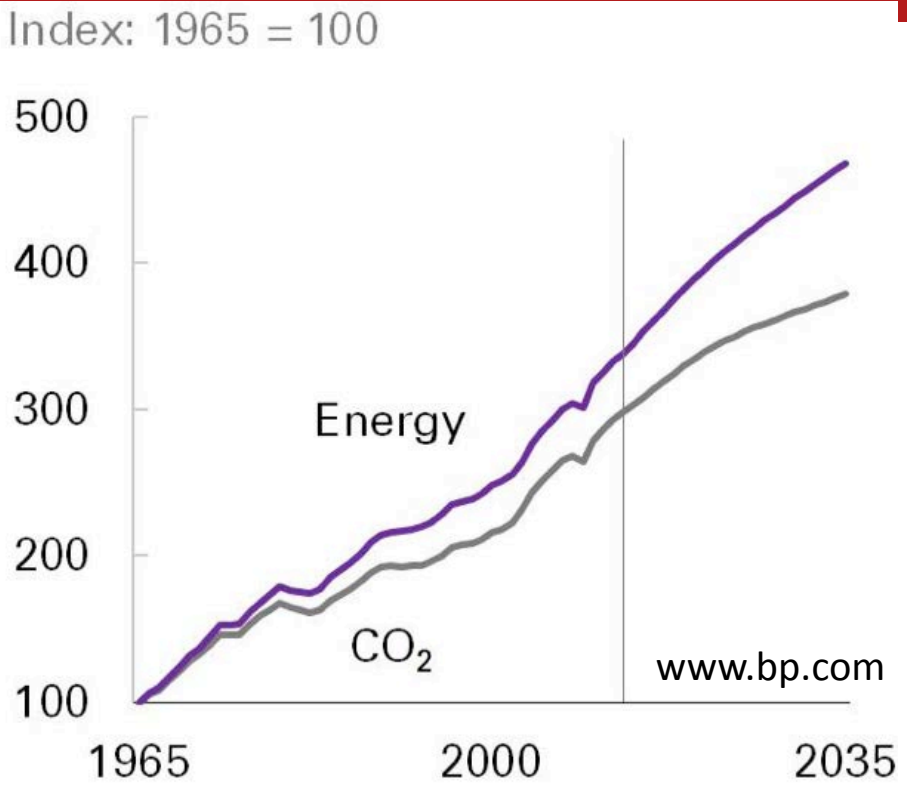


Water purification needs energy

Energy production generates waste water

The Problem: Current & Future Energy Needs





Intensify Development of Renewables

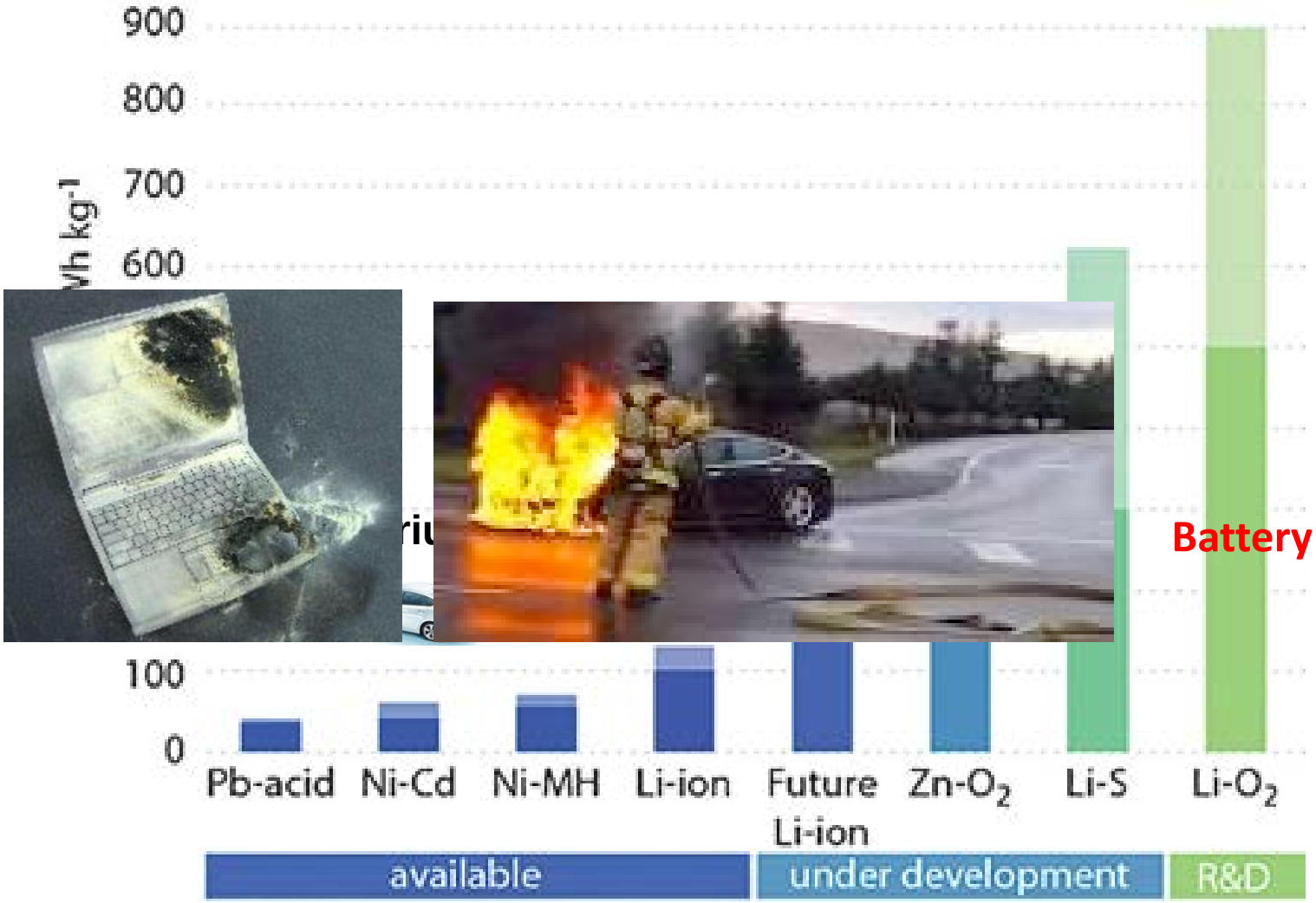
Energy Conversion and Storage (Intermittency)

Continue Oil & Gas Exploration and Production

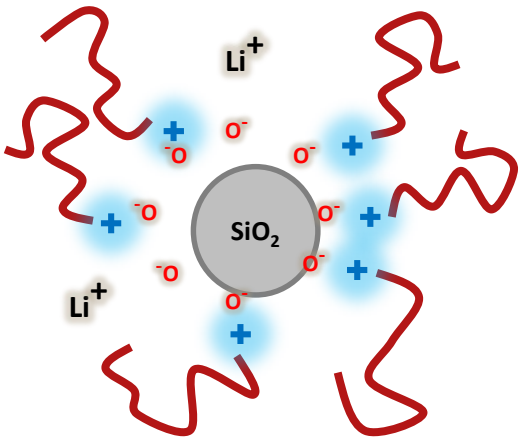
Develop and Implement Carbon Capture and Conversion

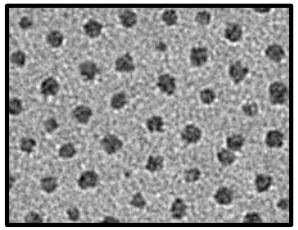
Electrical Storage: Batteries

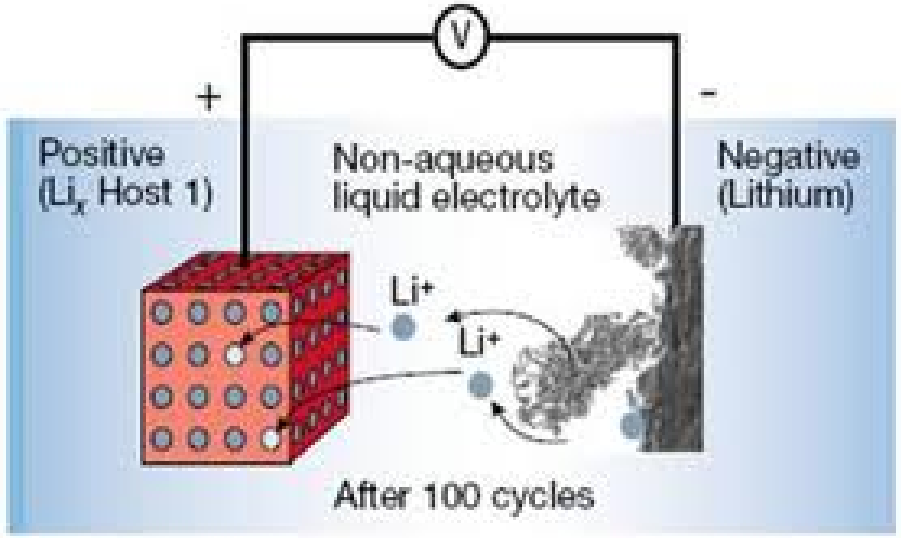
Battery Fires

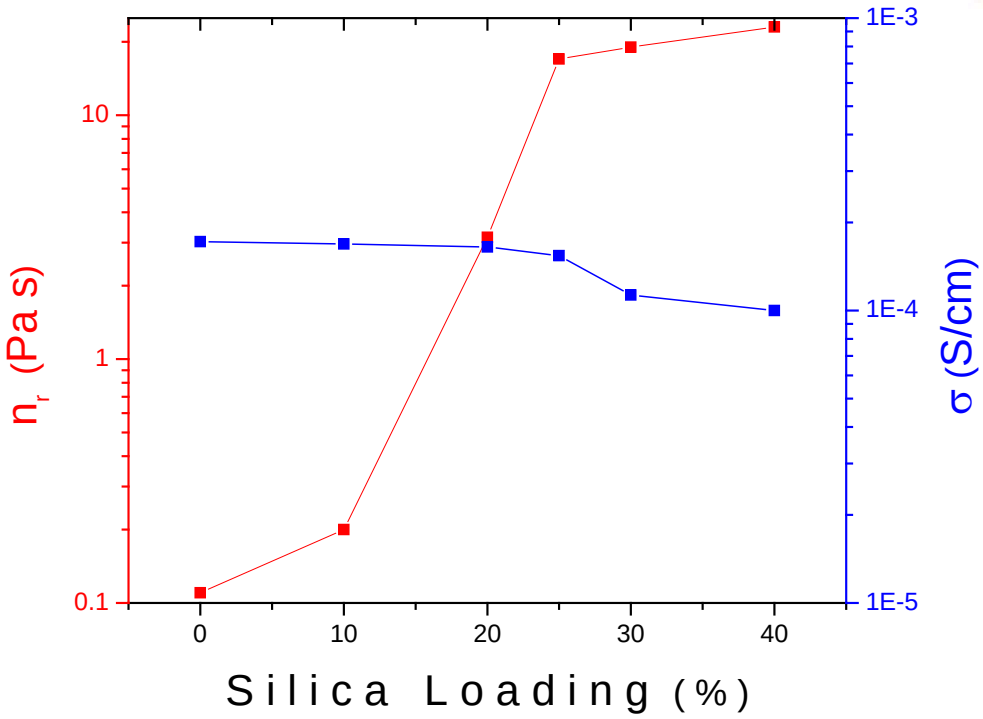


Hybrid Electrolytes: Performance



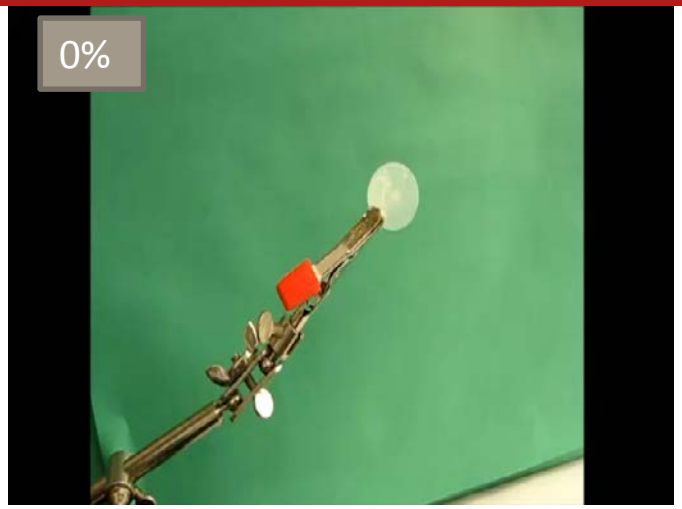


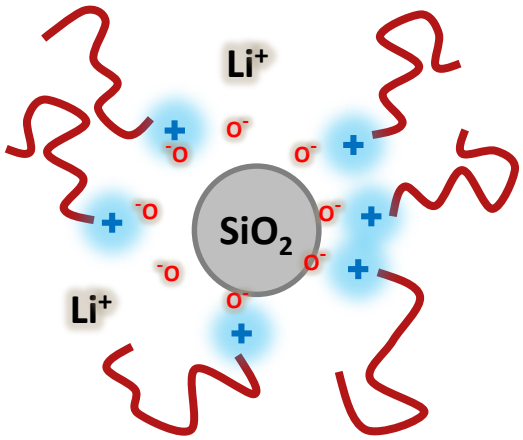


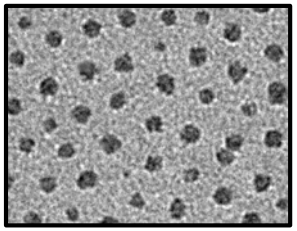


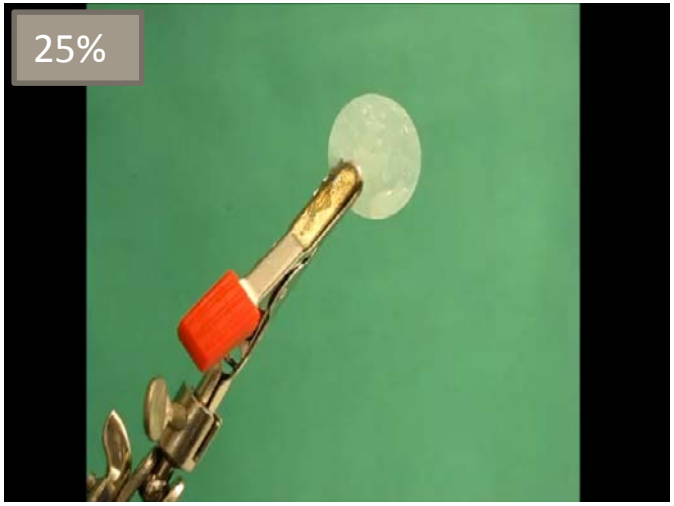
High stiffness helps to prevent dendrite formation

Hybrid Electrolytes: Flammability

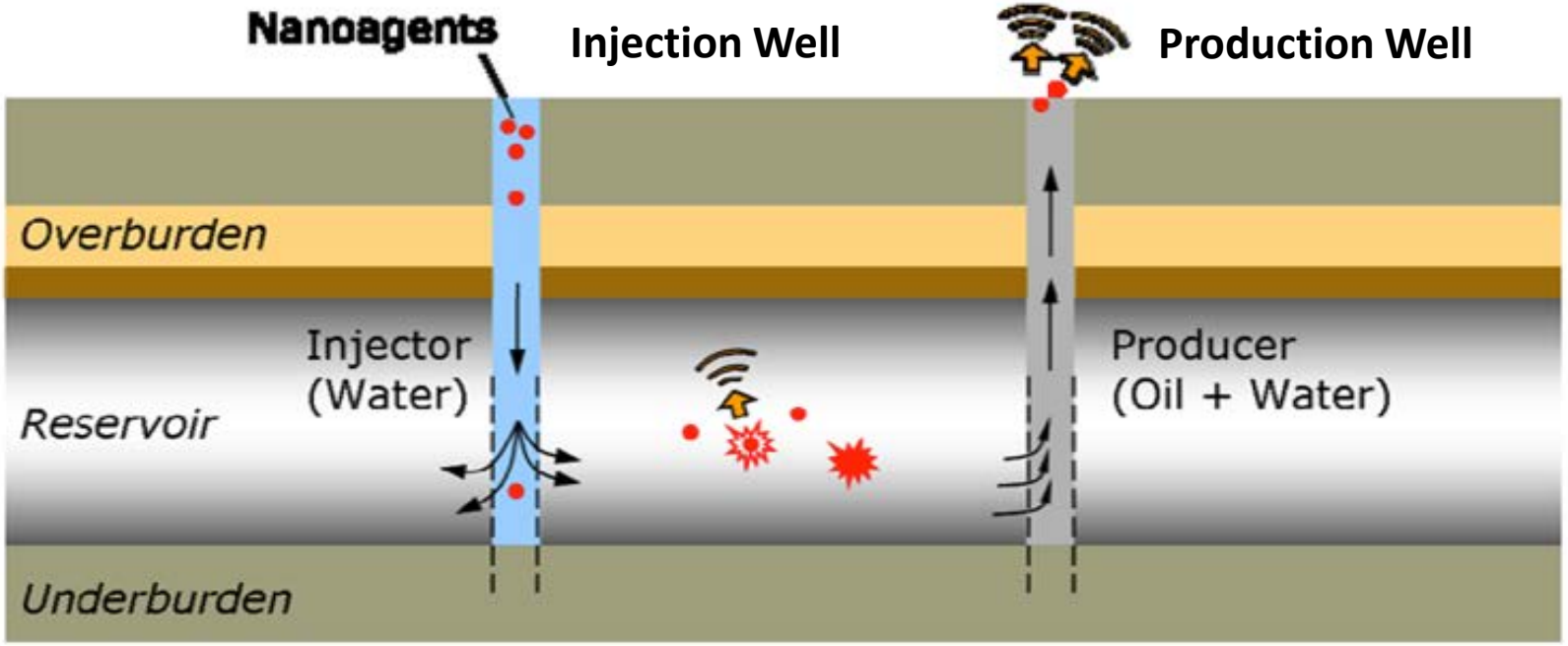








NP Reservoir Monitoring & Remediation

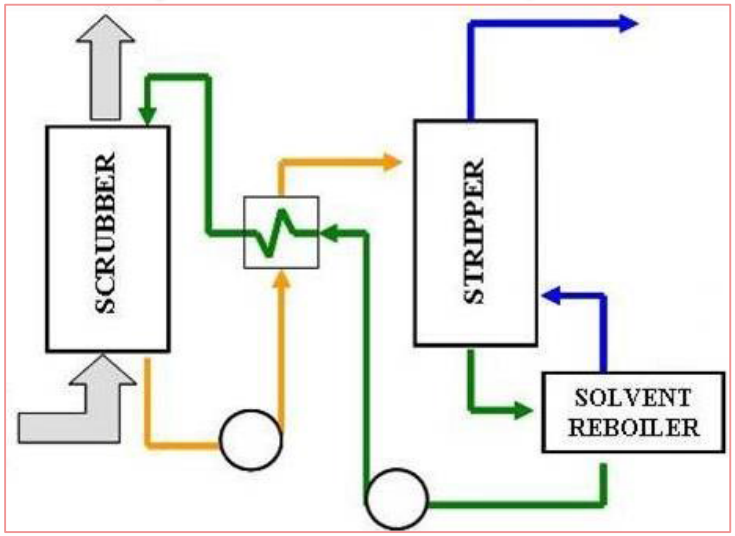


- **Map well connectivity (injection wells/production wells)**
  What is the T, P, pH, salinity in the reservoir?

- **Estimate oil saturation**
  is oil present in droplets or big continuous patches?

- **Deliver surfactants/chemicals into the reservoir in controlled release fashion**

Carbon Capture Technologies



40% of CO_2 emissions from power plants

Post-combustion capture has the greatest near-term potential for reducing CO_2 emissions

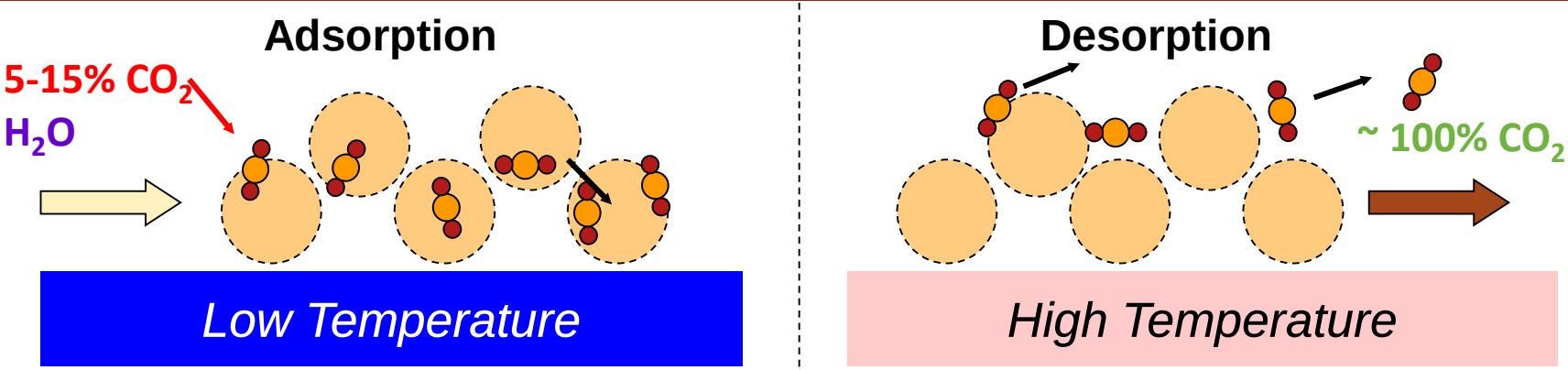
Challenge:

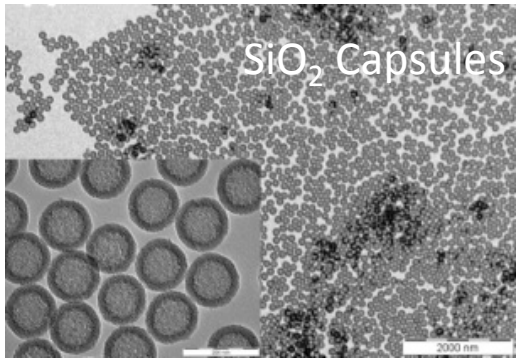
- **Low concentration of CO_2 in flue gas**
- **Often a mixture with other gases including H_2O**

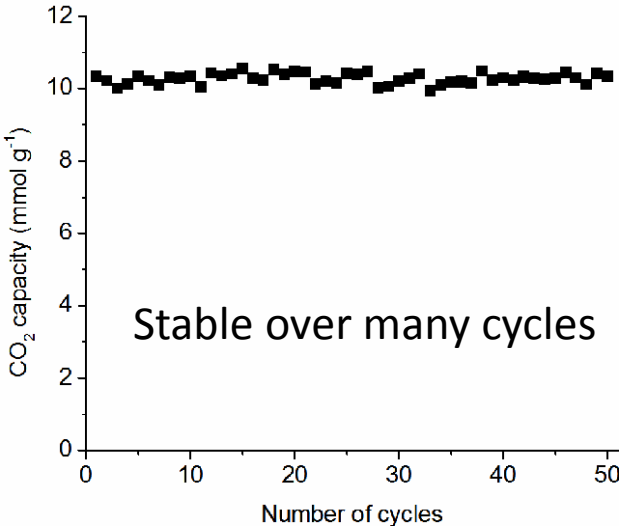
- **State of the art capture technology**
  - **Liquid amines scrubbers**
  - **Problems with evaporation and corrosion**

- **Potential Solution: Solid Amine Sorbents**
  - **Issue with capture capacity (<3 mmol/g)**

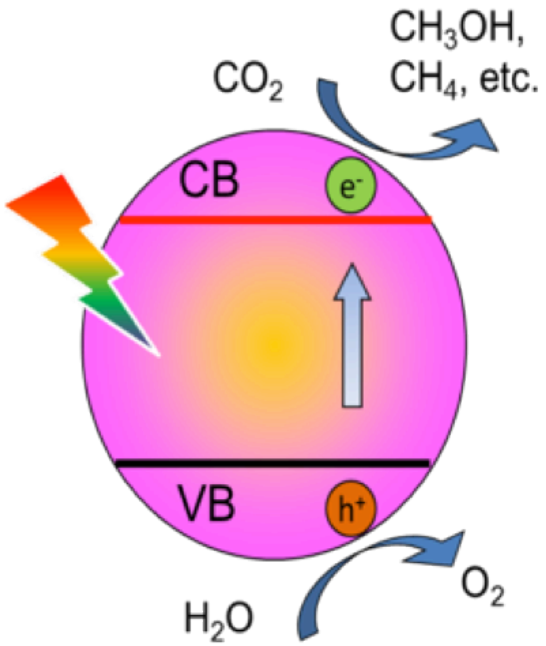
Solution: Solid Amine Sorbents



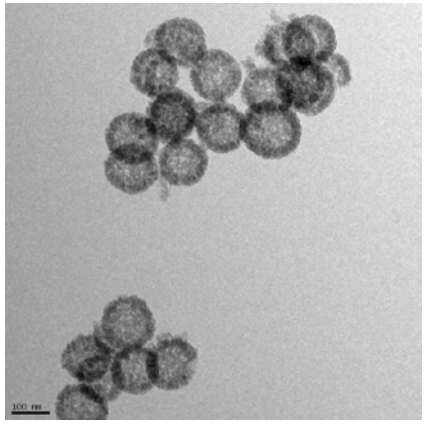




CO_2 Conversion



Conversion to Fuels



Conversion to Polyurethanes

NOVOMER

Carbonic Anhydrase/Magnetic Nanoparticles
CO_2 to Carbonate

ZYMtronix
Catalytic Systems

ENGRI1110: Nanotechnology for a Sustainable World

Freshman Engineering Course

Lectures
Labs
Student Projects and Presentations

Fuel Cell Lab Demo