Realizing iron pyrite (FeS_2) as a viable solar-energy-conversion material

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August 18, 2014

Overview

1. Solar energy, semiconductor materials and pyrite

2. Absorption spectroscopy

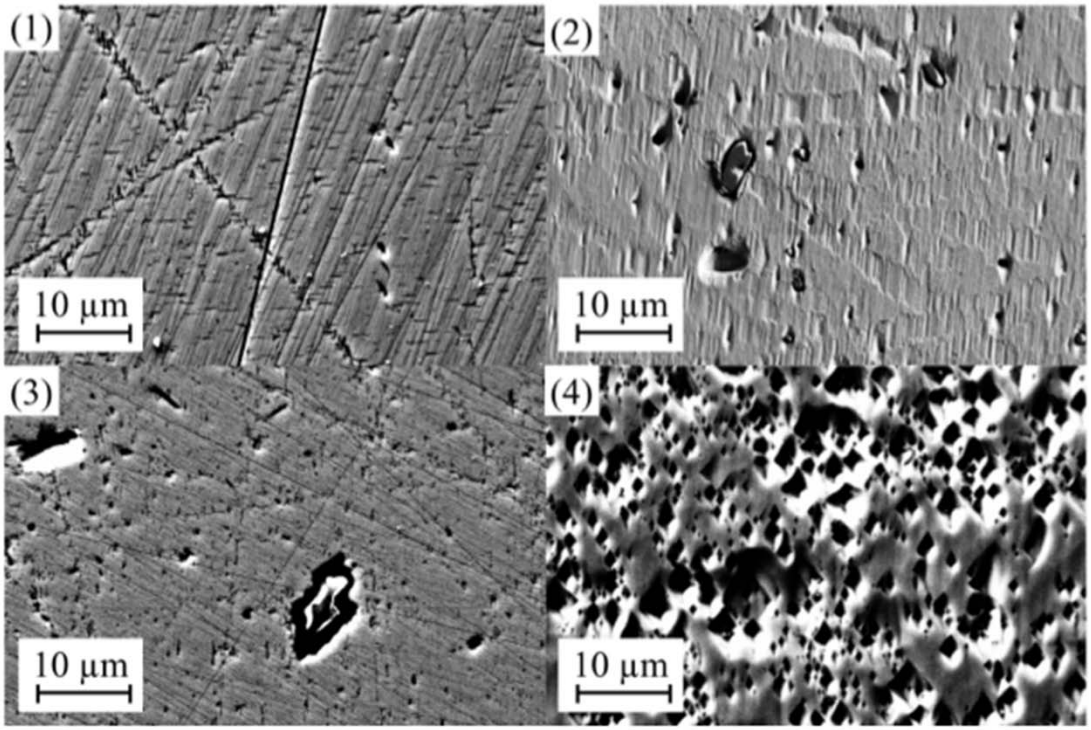
3. Treatments and improvements of pyrite

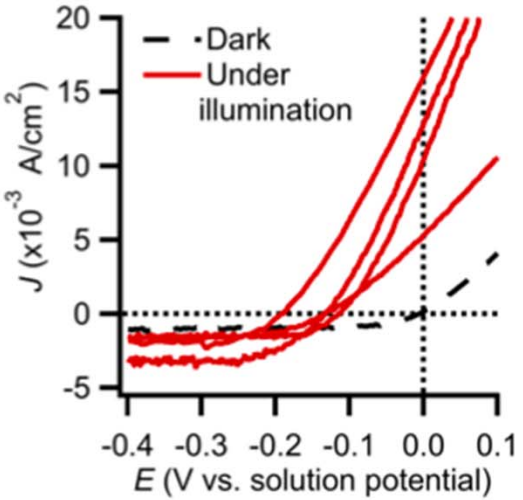
Iron Pyrite

- Strong absorption coefficient

- Works better as a solar-energy-conversion material (has a positive photoresponse) when treated

How electrochemical etching treatment affected photoresponse





Image, *J–V* curve

cathodically polarized in acidic media	(1, top)
anodically polarized in acidic media	(2, 4th)
cathodically polarized in basic media	(3, 3rd)
anodically polarized in basic media	(4, 2nd)

Absorption Spectroscopy

- Measures absorbance of a material at different wavelengths of light to help identify molecular bonds oscillating at that wavelength

Improving pyrite's performance

- Two species used: natural and synthetic

- Understanding chemically impurities and defect sites with the help of absorption spectra

- Using chemical and physical treatments to cause, characterize, and treat impurities and defect sites

Four Pre-treatments:

- Wet and dry grinding (water)

- Sulfuric Acid (H_2SO_4)

- Potassium Hydroxide (KOH)

- Heating at 150 degrees C for 30 minutes

Two Chemical Treatments

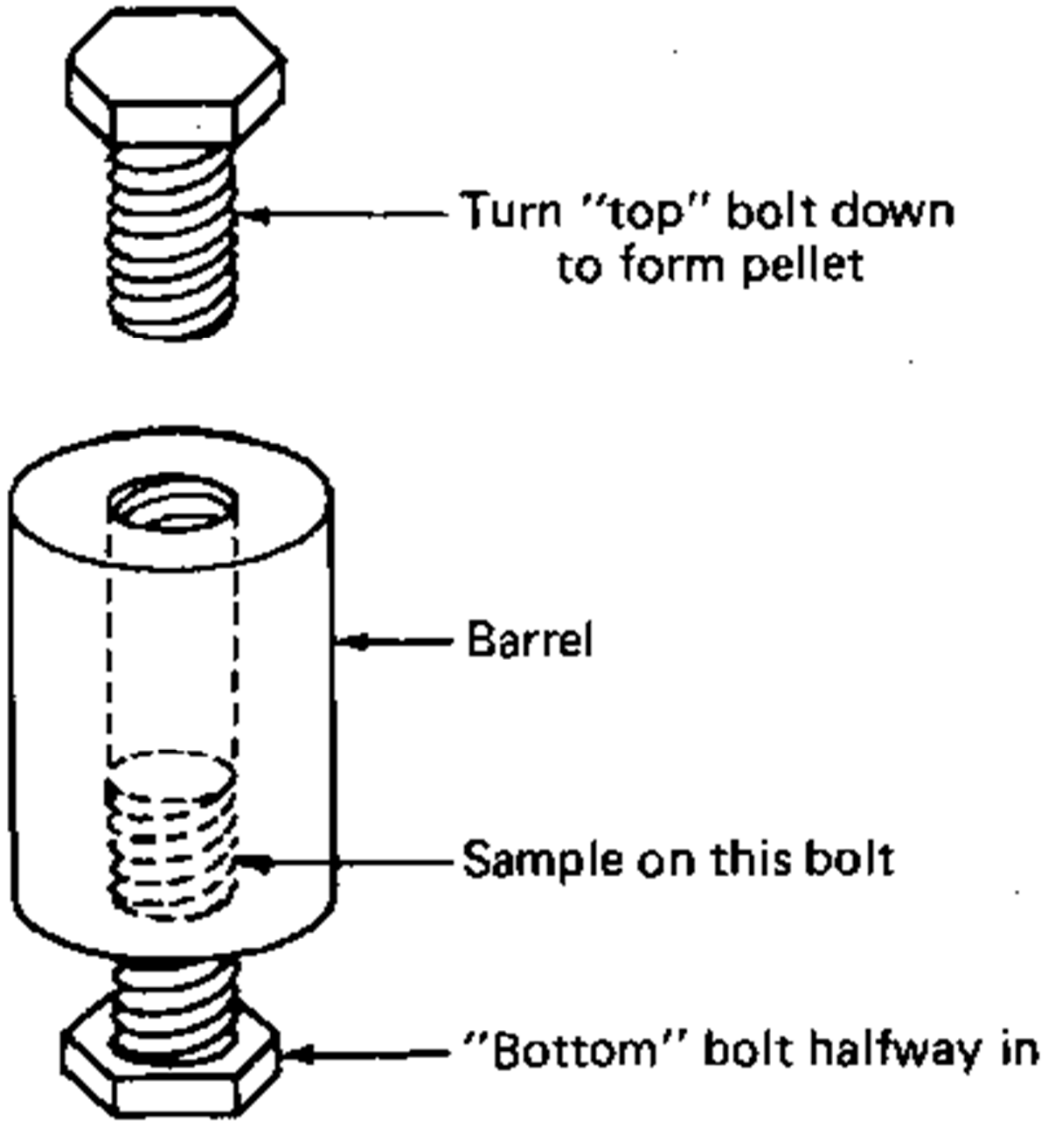
- Potassium Iodide (KI)
    - Iodine is the best redox couple for pyrite

- Iron Chloride ($FeCl_3$)
    - Another redox couple for pyrite
    - Prevents degradation in water
    - Potentially oxidizes pyrite

Control Samples

- Chalcopyrite (copper iron sulfide mineral)

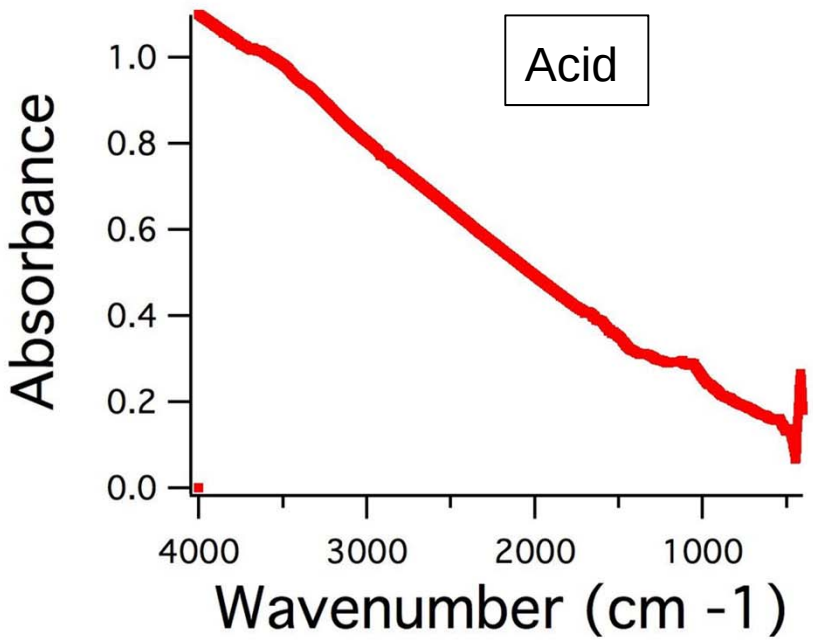
- Marcasite (FeS_2 with a different crystalline structure)

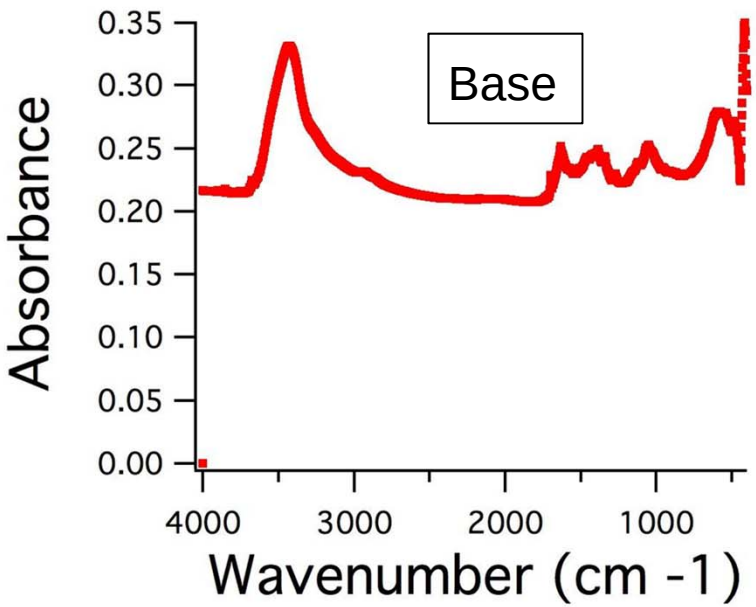


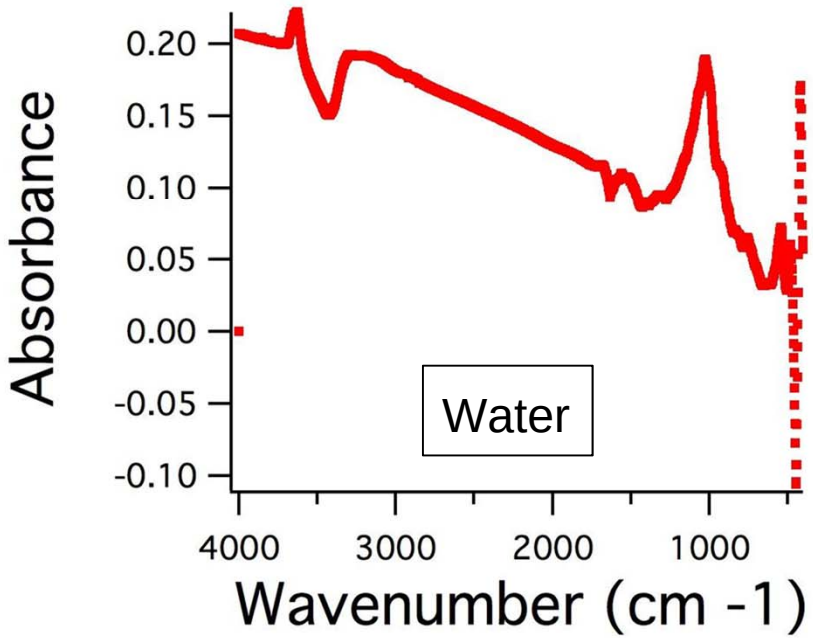
KBr pellet press

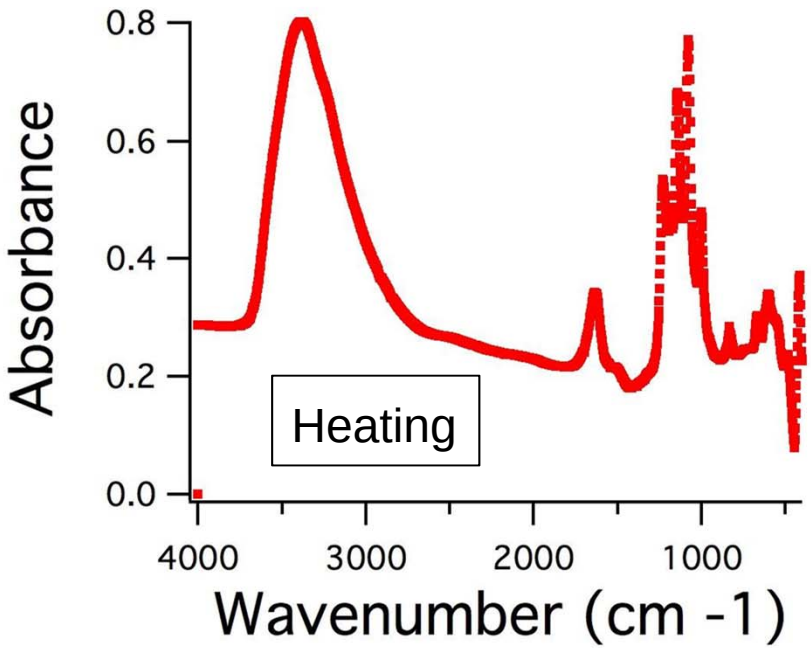
Nicolet 6700 FT-IR machine

Pre-treated natural pyrite absorption spectra

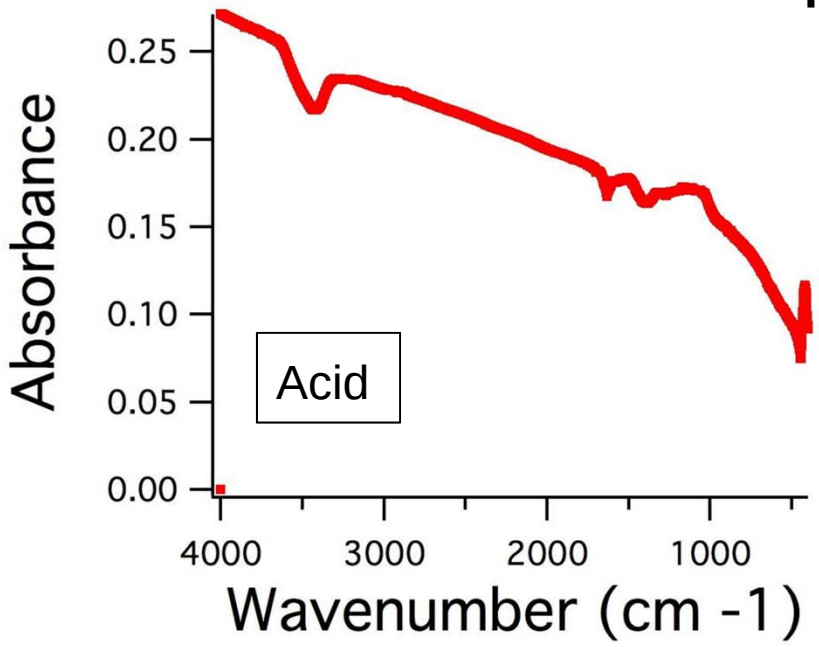


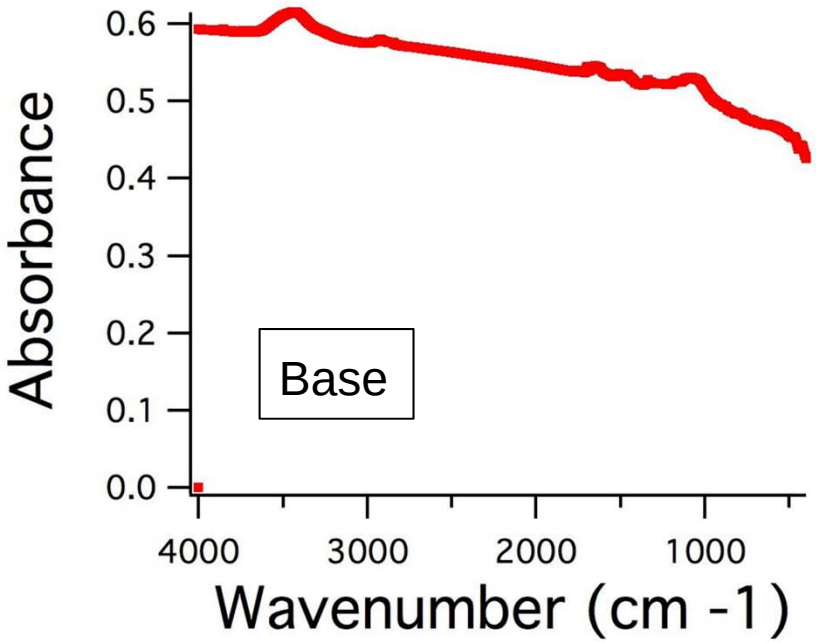


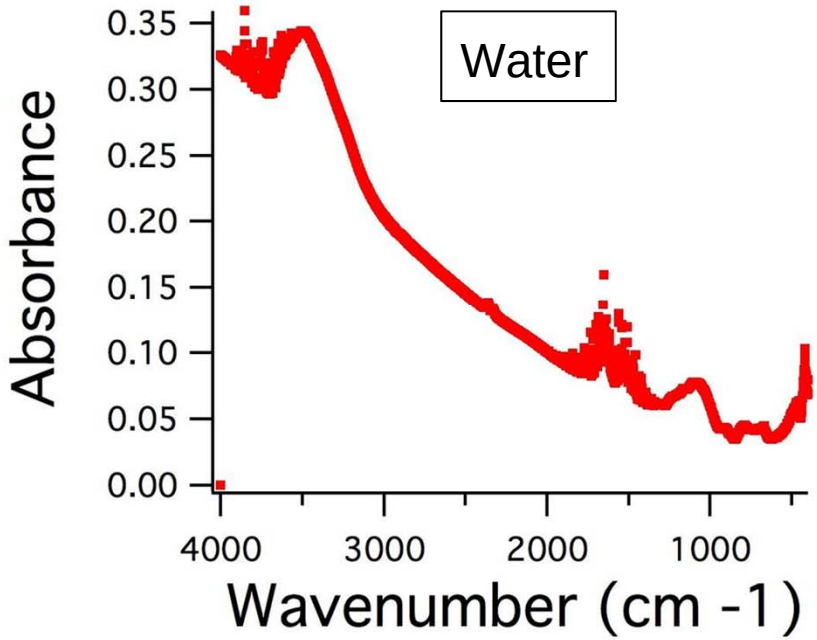




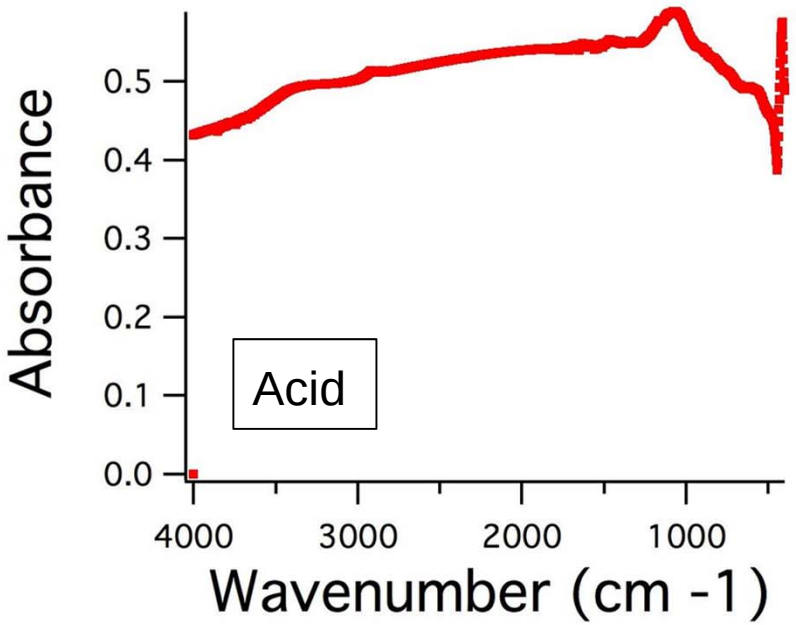
KI-treated natural pyrite absorption spectra

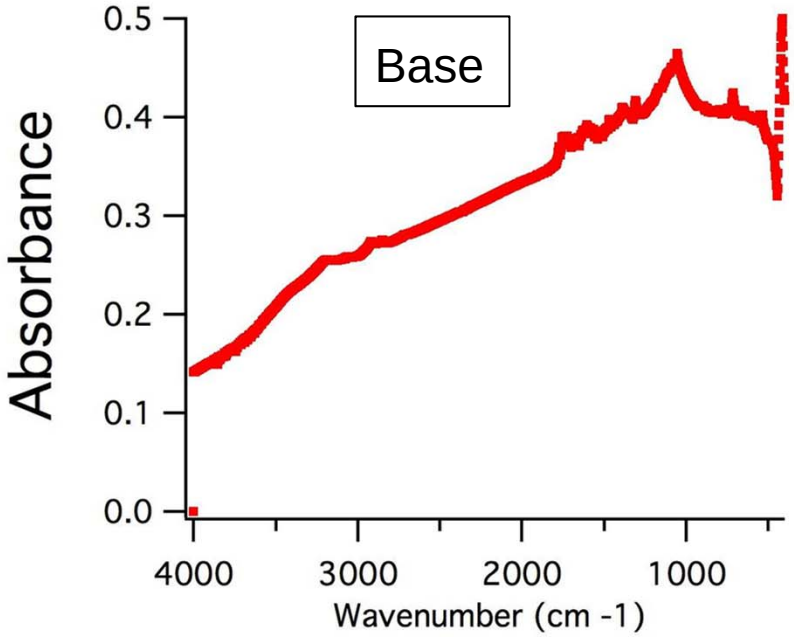


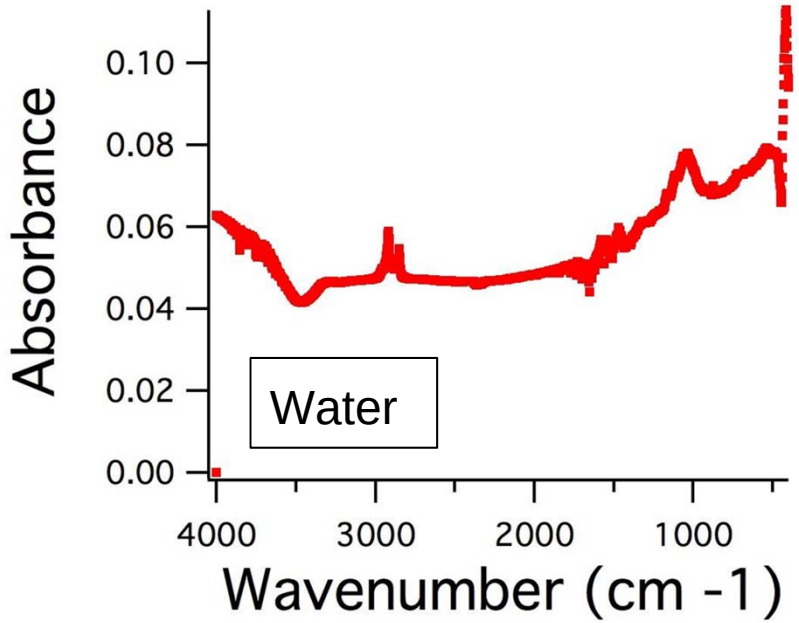




$FeCl_3$-treated natural pyrite absorption spectra







Future Work

- Further characterize treatments

- Apply treatments

- Find fitting materials to pair with pyrite

- Produce a working solar cell utilizing pyrite

References

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Image Citations

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Acknowledgements

Professor Erik Johansson
Professor Erik Sanchez
Professor Jun Jiao

Qi Tong
Eric Young

PSU's REU Coordinator,
Meaghan Corwin

Portland State
UNIVERSITY