

Fundamental Investigations of Nanostructured Chemical Sensing Layers

Research &
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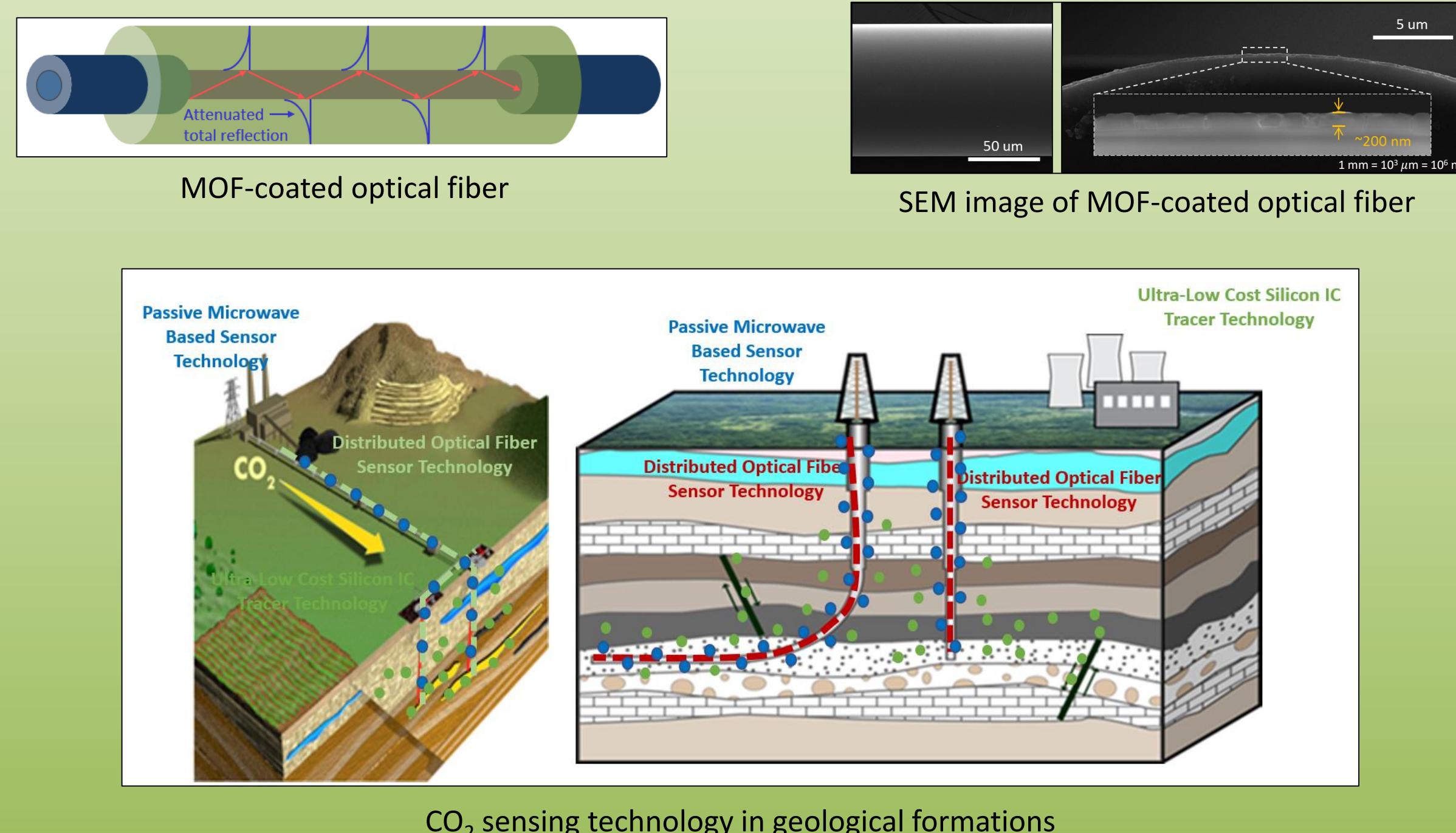
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Abstract

Fiber optic sensors can be coated with metal-organic frameworks (MOFs) to deliver a viable CO₂ sensing technology. This sensing technology is relevant for Carbon Capture and Storage (CCS) where it can be used to monitor CO₂ in geological formations. Fundamental investigations of these nanostructured chemical sensing layers, using Fourier Transform Infrared (FTIR) Spectroscopy, provided validating results of the MOF coated sensor to have a high selectivity to CO₂ relative to other small gases. Research was also conducted to investigate how the presence of a redox-active, conjugated guest molecule affects the MOF's selectivity of CO₂. The MOF under investigation was Cu₃(BTC)₂ (benzene-1,2,5-tricarboxylic acid) and the redox-active molecule was TCNQ (7,7,8,8-tetracyanoquinodimethane). This MOF was selected for its high absorption of small gases due to tunable conductivity. The promising results of the project indicate that Cu₃(BTC)₂ coated fiber optic sensors can be used not only in optical sensing applications such as monitoring CO₂ in geological formations for CCS, but also in industrial process applications such as monitoring flue gas of power plants.

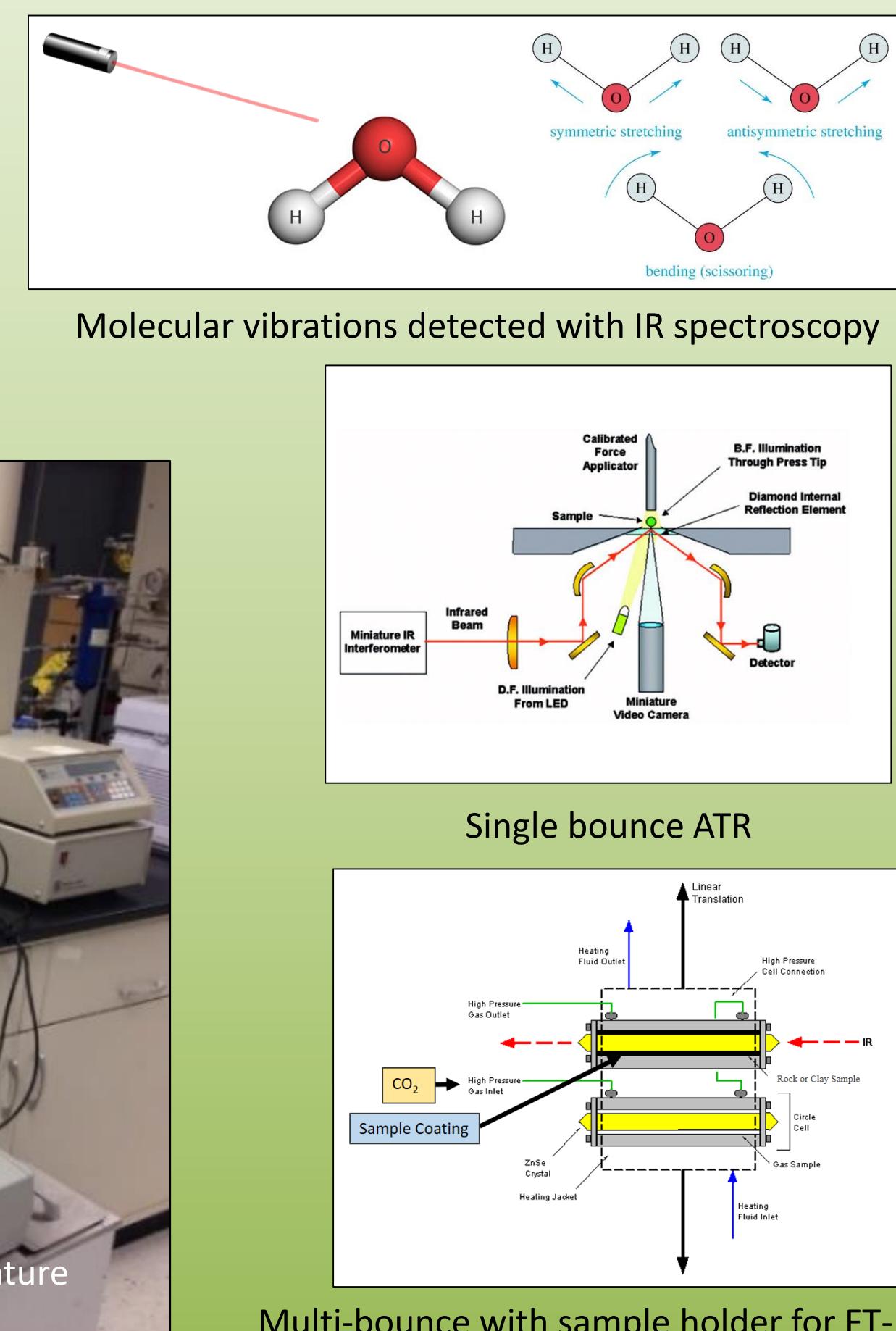
Project Overview

Fiber optic sensors can be coated with metal-organic frameworks (MOFs) to deliver a viable CO₂ sensing technology in geological formations relevant for Carbon Capture and Storage (CCS) applications.



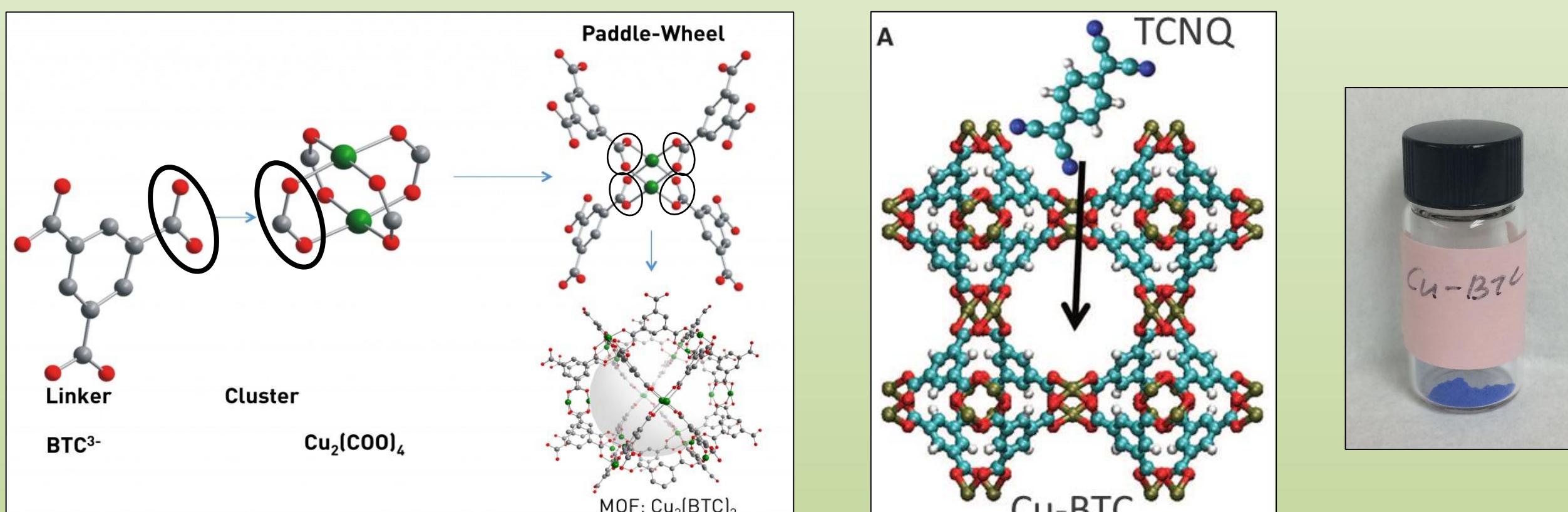
Infrared Spectroscopy

- Infrared spectroscopy analyzes the interaction of infrared light with a molecule.
- The analysis is based on measuring the vibrations of atoms that are specific for each functional group.

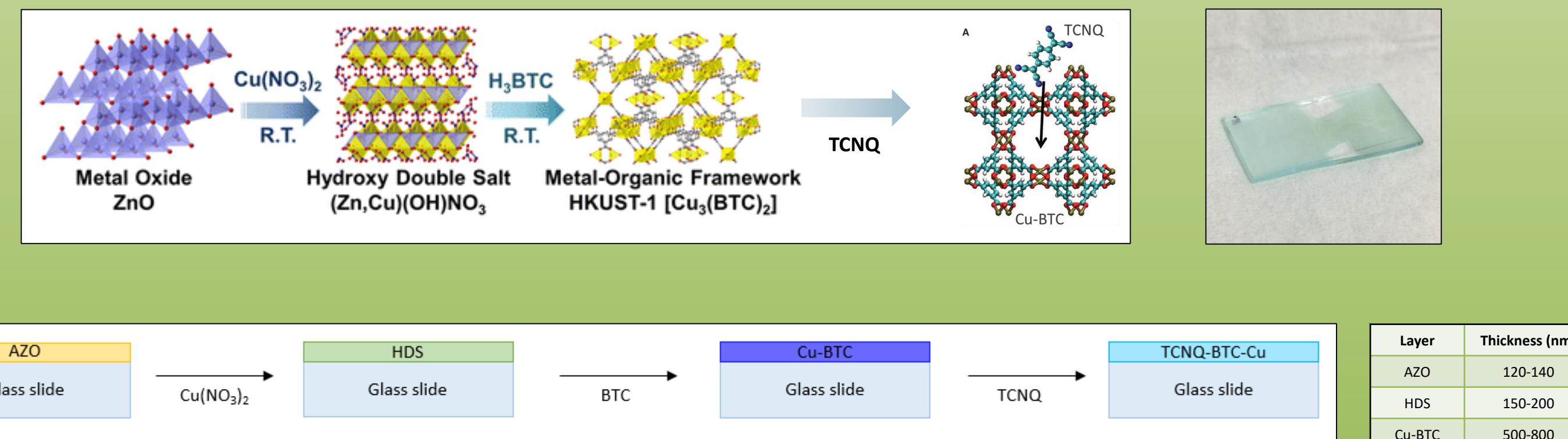


Metal Organic Framework Synthesis

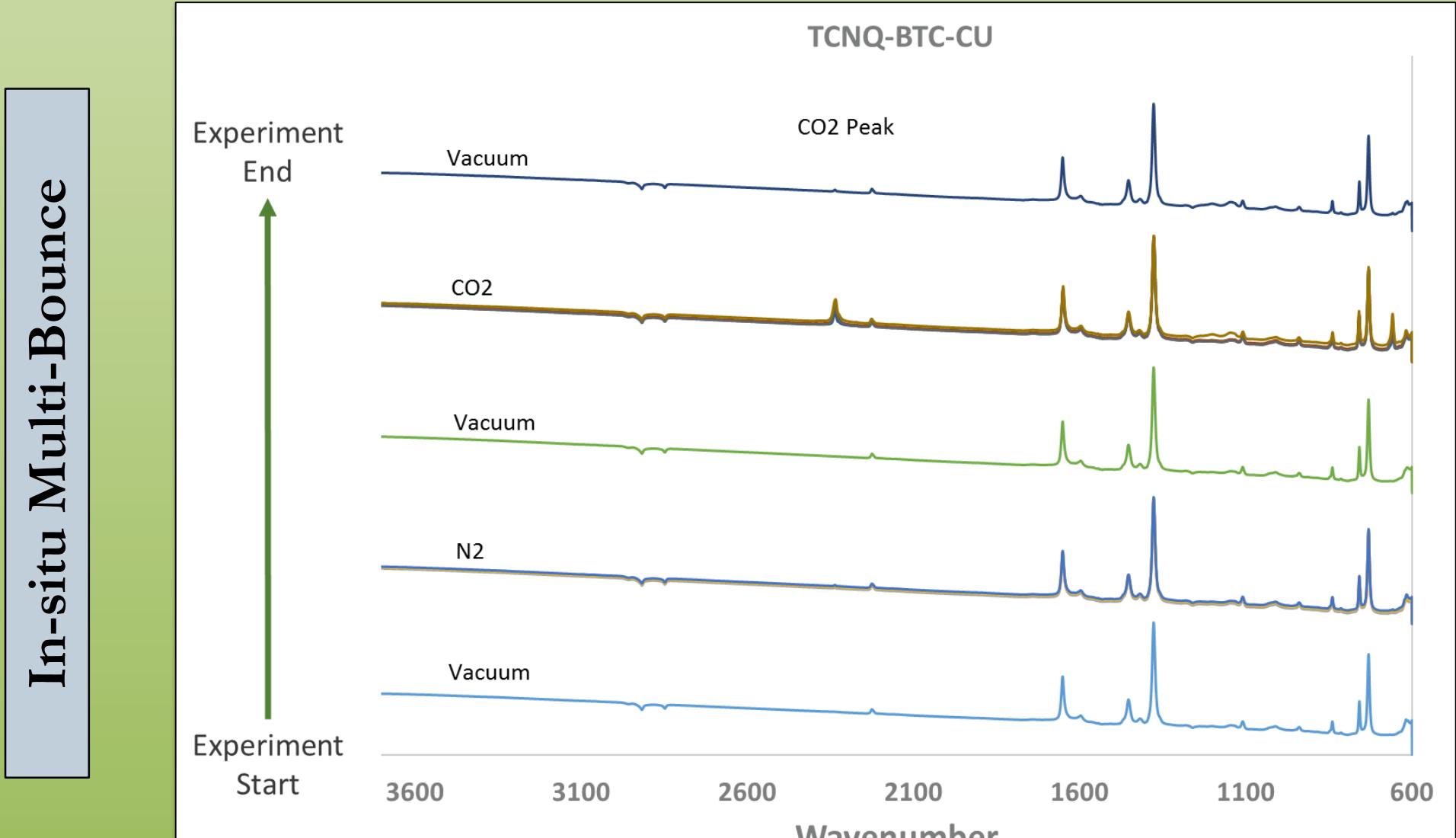
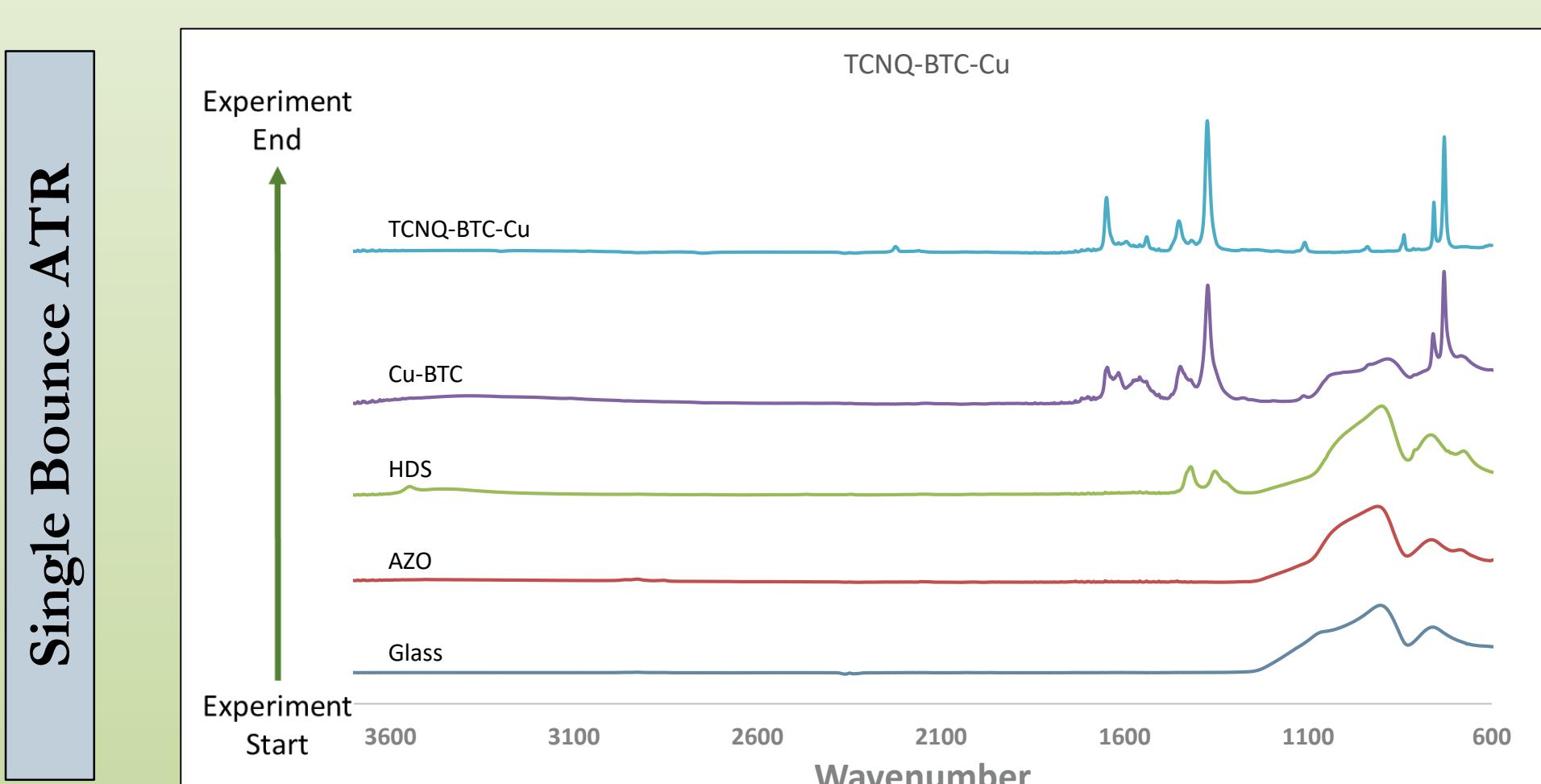
Solvothermal Synthesis Method



Thin Film Synthesis on Silica Glass Substrate



Infrared Spectroscopy: Results



Conclusions

- IR spectroscopy is part of the tool set
- Provided insight into the selectivity to CO₂ relative to other small gases
- Determined successful synthesis of thin film Cu₃(BTC)₂
- MOF coated fiber optic sensors can be used in:
 - Geological formations for CCS
 - Flue gas of power plants
 - Natural gas pipelines

References

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