



Application and Synthesis of Electrospun Nanofibers for the Desulfurization of Hydrocarbon Streams

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BACKGROUND

- Gas and oil industries use metal oxide powders to remove sulfides from hydrocarbon streams.
- Electrospun nanofibers are versatile, **high surface area adsorbent materials** that can be applied in the removal of sulfides.

OBJECTIVE

- Assess the application of nanofibers in the adsorptive separation process in terms of **improving efficiency and lowering cost.**

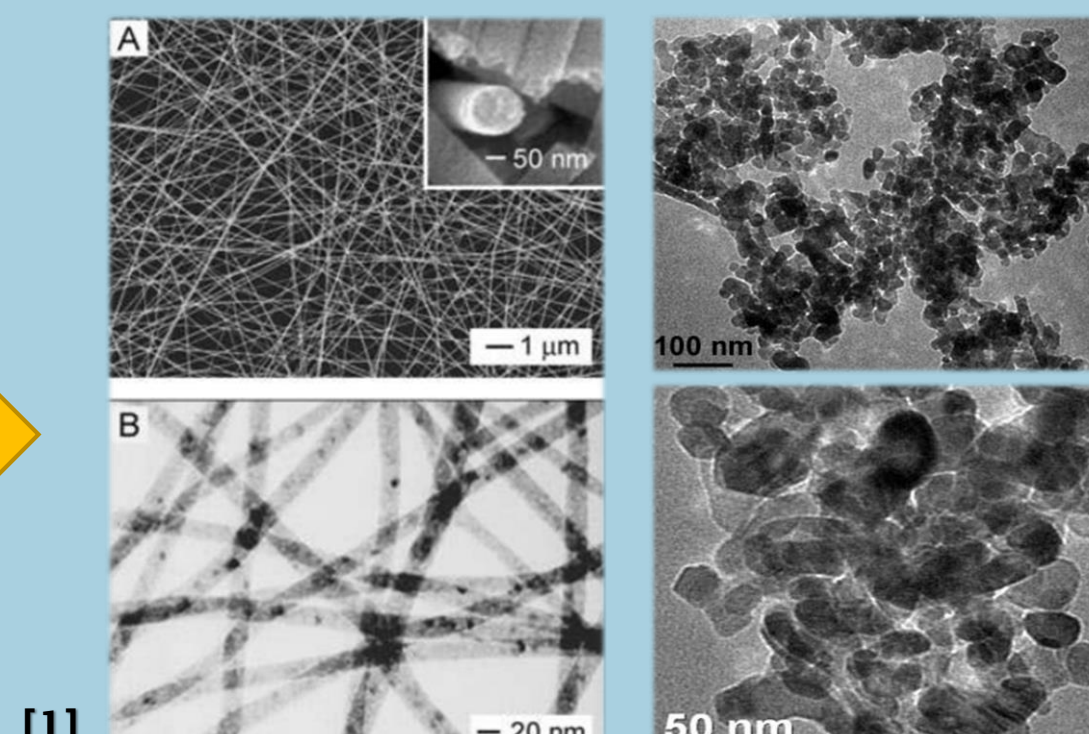


EXPERIMENTAL PROCEDURE



Synthesis

- Build and operate an electrospinning chamber for the synthesis of metal oxide nanofibers.



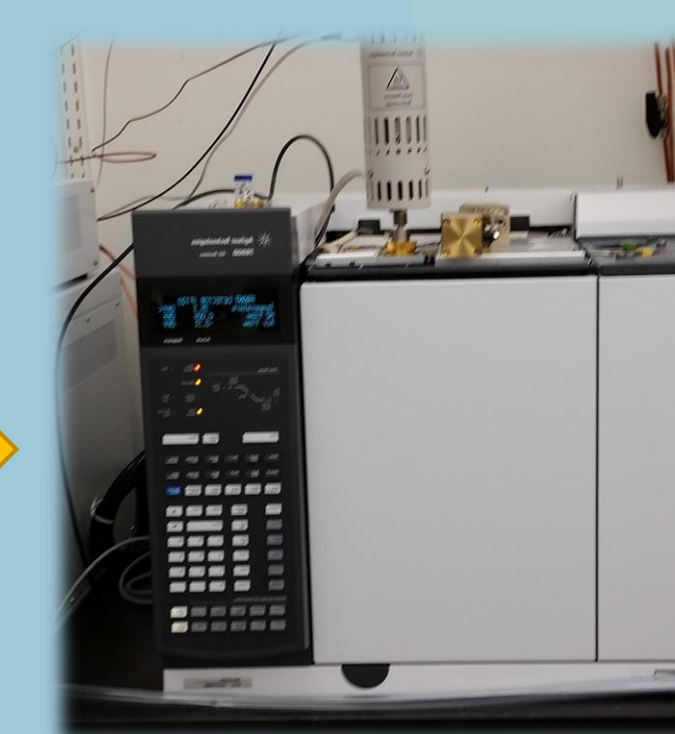
Analysis

- Compare nanofiber and powder particle surface area using a surface area analyzer.



Application

- Pack synthesized nanofibers and powders into a fixed bed reactor system and apply sulfides.



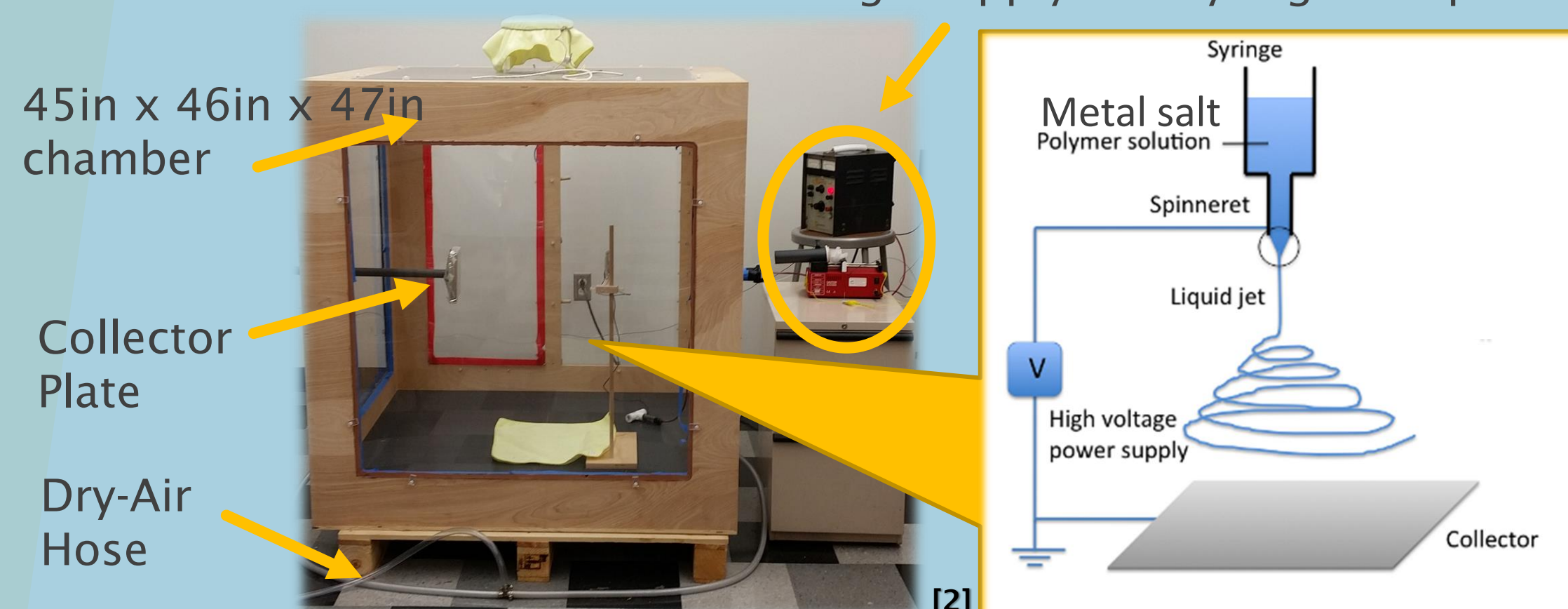
Quantification

- Quantify remaining sulfides using GC-MS (gas chromatography-mass spectrometry) and compare.

SYNTHESIS OF ELECTROSPUN NANOFIBERS

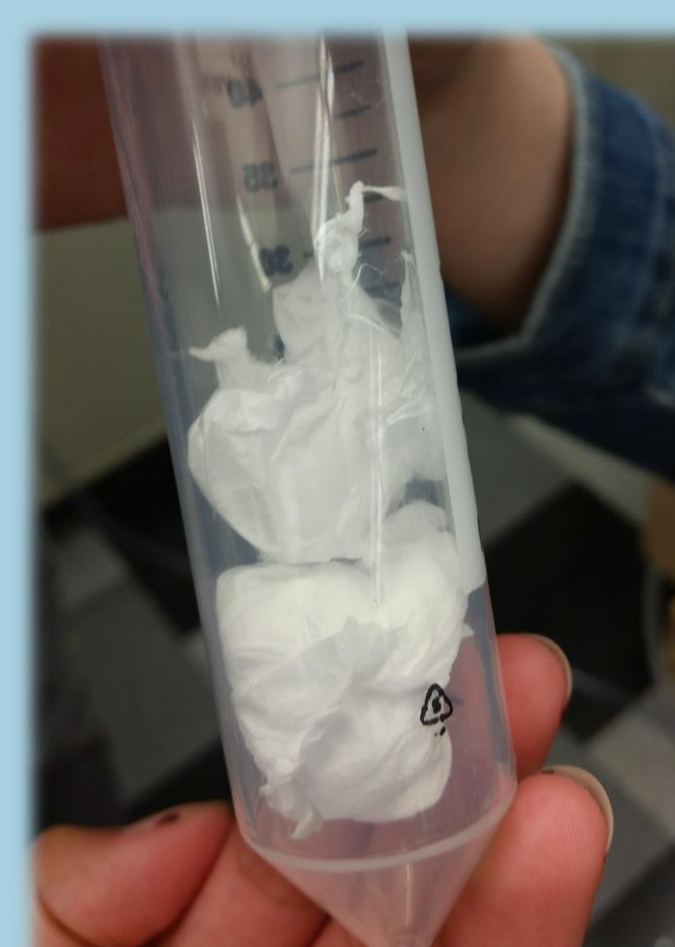
Electrospinning Set-Up

Voltage Supply and Syringe Pump



Components are all attached to each other to form an electric circuit as dry air is flowed into the chamber at 5ft³/min.

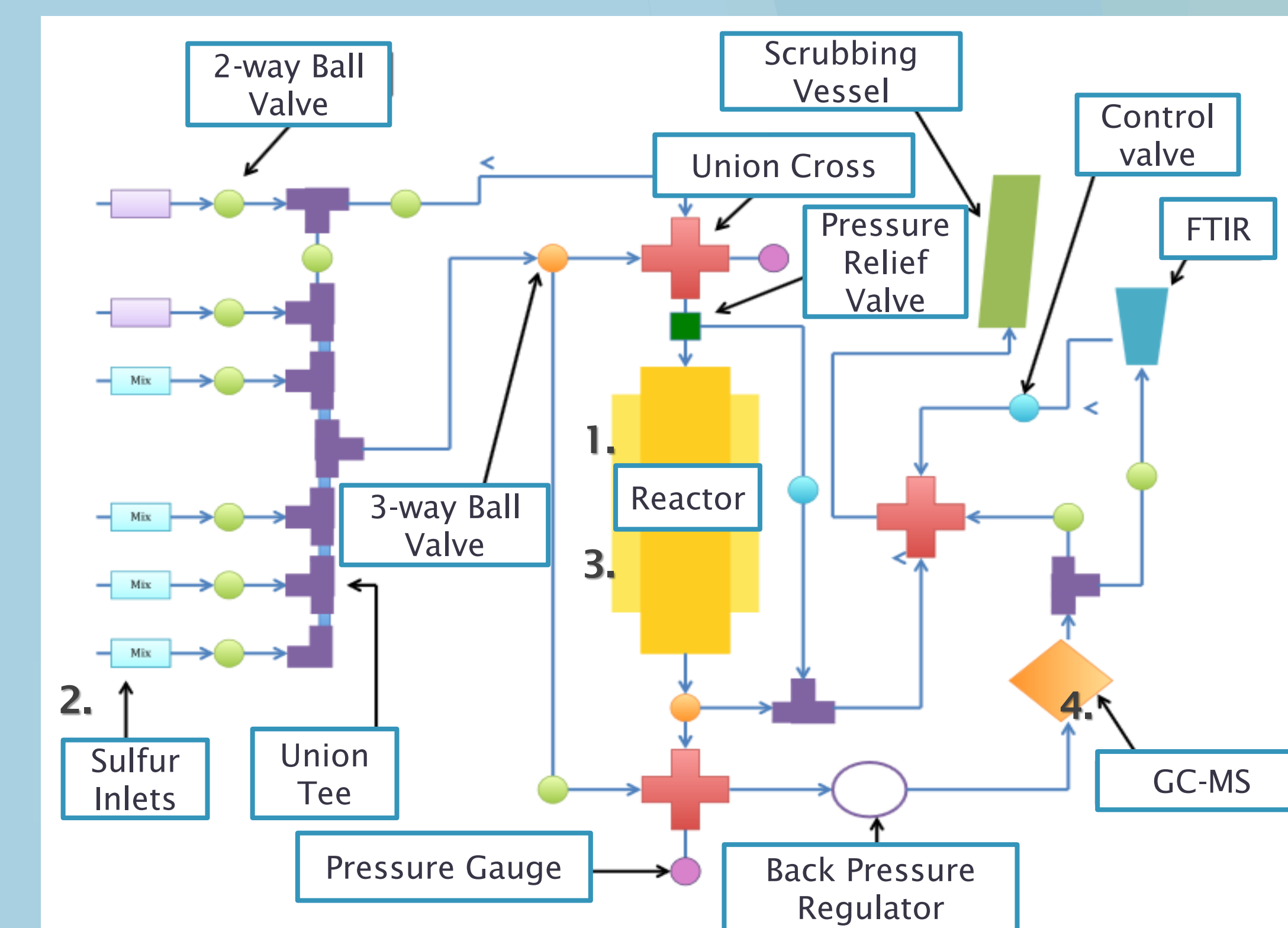
25kV voltage is applied to a needle where metal oxide nanofibers are jetted and collected onto a grounded metallic collector plate.



Synthesized fibers are calcined by heating from 50° C to 625° C for 17 hours at a rate of 0.4 ° C/min in an oven.

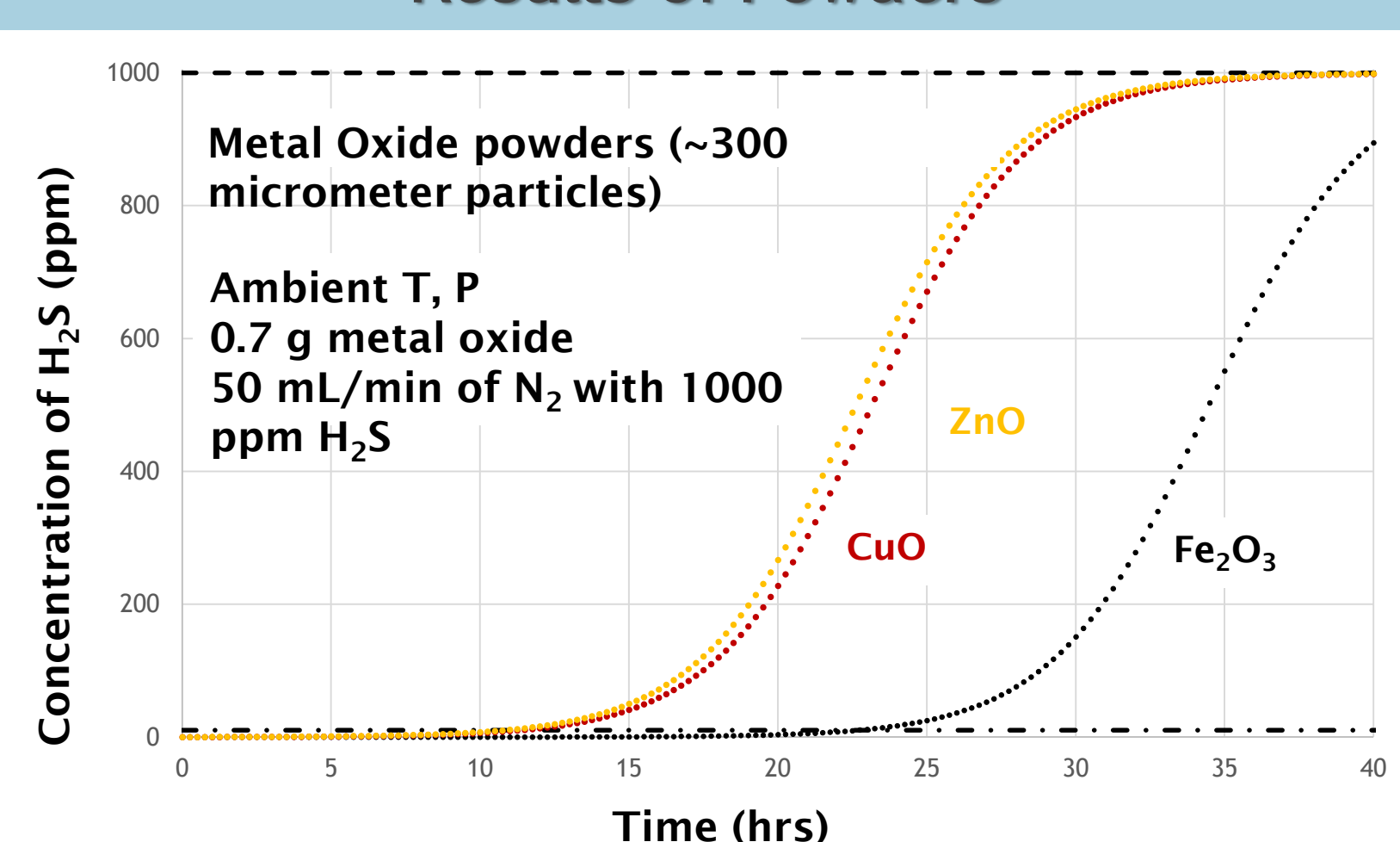
ADSORPTIVE CATALYSIS IN A FIXED BED REACTOR

- Metal oxide fibers and powders are respectively packed inside a fixed bed reactor.
- Sulfides (H₂S) are fed through last four inlet streams to the reactor in a flow rig.
- Streams of H₂S reach the reactor bed where they **adhere** to the surfaces of the fibers/powders.
- GC-MS measures the difference of the starting amount of sulfides and the ending amount.



EFFICIENCY IN REMOVAL OF SULFIDES

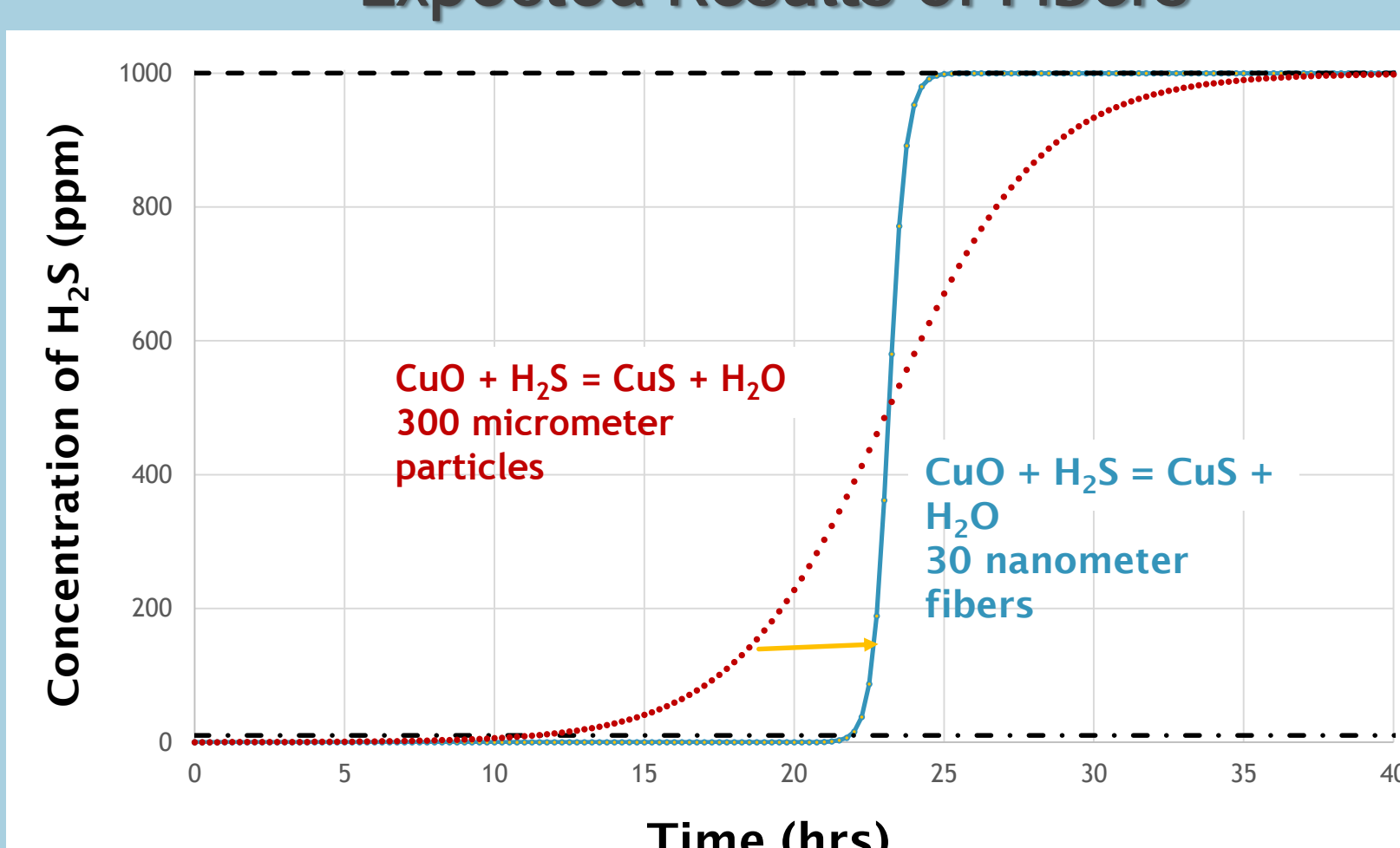
Results of Powders



Key
• ZnO
• Fe₂O₃
• CuO
• CuO (fiber)

Fe₂O₃ lasted the longest collecting.

Expected Results of Fibers



The nanofibers are expected to last longer than fibers because there will be more surface for sulfides to adhere to.

DISCUSSION AND FUTURE WORK

- We hope to implement metal oxide fibers in place of powders to lower the cost of sulfide removal and to improve the quality of gas and oil within environmental guidelines.
- The fibers should react with more moles of H₂S (per mole of metal oxide) and last longer collecting therefore having a longer lifetime.**
- Additionally this allows sulfide, a valuable raw material, to be reclaimed during adsorption and used for subsequent productions.

REFERENCES

- Li, D. and Xia, Y. (2004), Electrospinning of Nanofibers: Reinventing the Wheel?. Adv. Mater., 16: 1151-1170. doi:10.1002/adma.200400719
- Fengyu Li, Yong Zhao and Yanlin Song (2010). Core-Shell Nanofibers: Nano Channel and Capsule by Coaxial Electrospinning, Nanofibers, Ashok Kumar (Ed.), ISBN: 978-953-7619-86-2, InTech, DOI: 10.5772/8166.

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