

# Molybdenum Coupled Electrochemical Sensing Systems

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# Introduction and Problem Statement

To improve the efficiency of crop production, we are developing devices to conduct widespread agricultural monitoring of nutrients and environmental factors. Electronics for this application must be low-cost, able to deliver easily accessible data directly to farmers, and disappear after their functional lifespan.

Overarching topics addressed this summer:

- Electrochemical sensors and power sources
- Transient materials
- Energy output dependent on concentration of phosphate

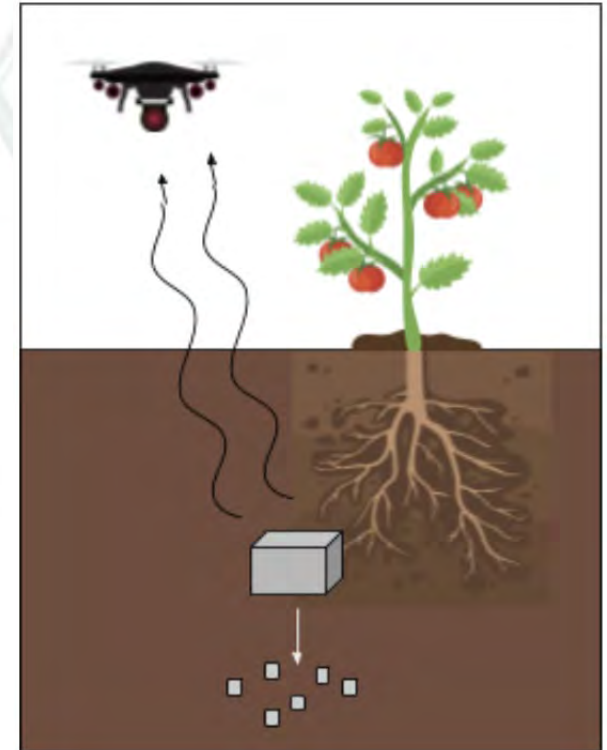


Figure 1: Schematic of overall goal

# Overview of the Technical Approach

- Molybdenum has shown selectivity towards phosphate and is presently used in dissolvable electronics
- Test the possibility of a phosphate sensor made out of transient materials that detects plant available phosphates (PAPs) found in soil
- Two different approaches
  - potentiometric
  - amperometric

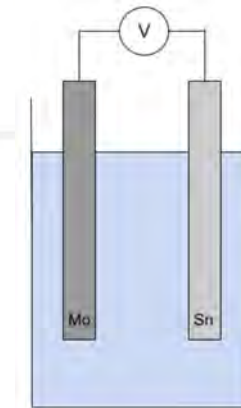


Figure 2: Electrochemical cell schematic



Figure 3: Experimental set-up

# Results

Concentration vs. Voltage after 1000 seconds

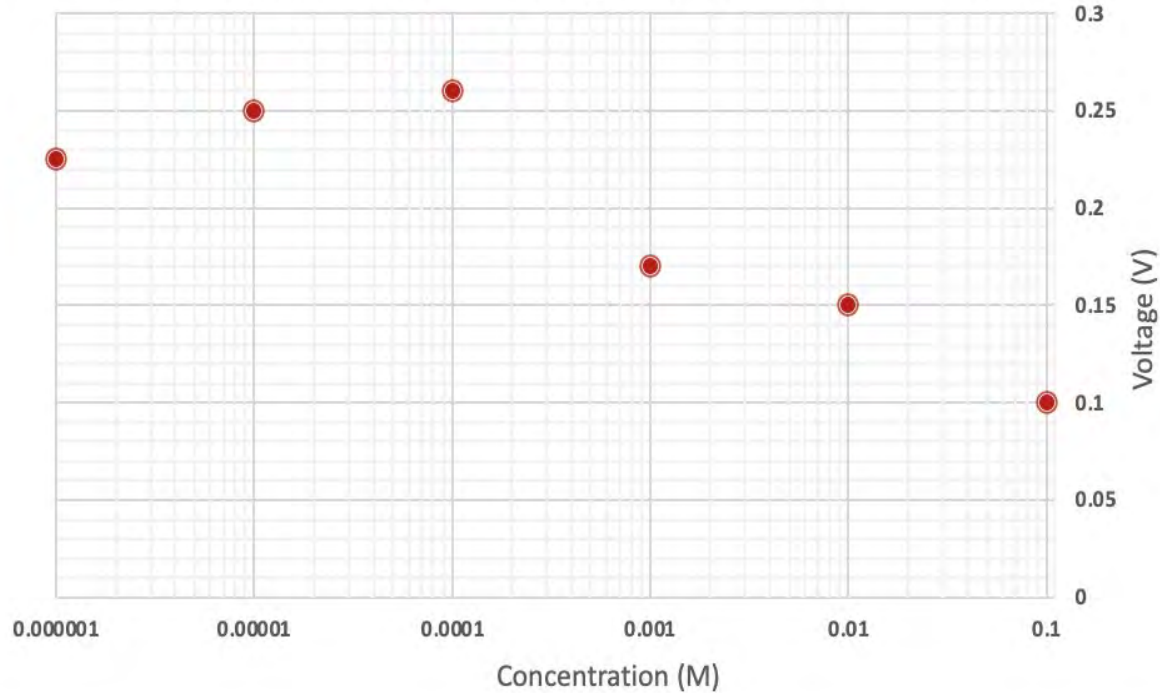


Figure 4: Open circuit potential results

Current vs Concentration at 1.2 V (increasing)

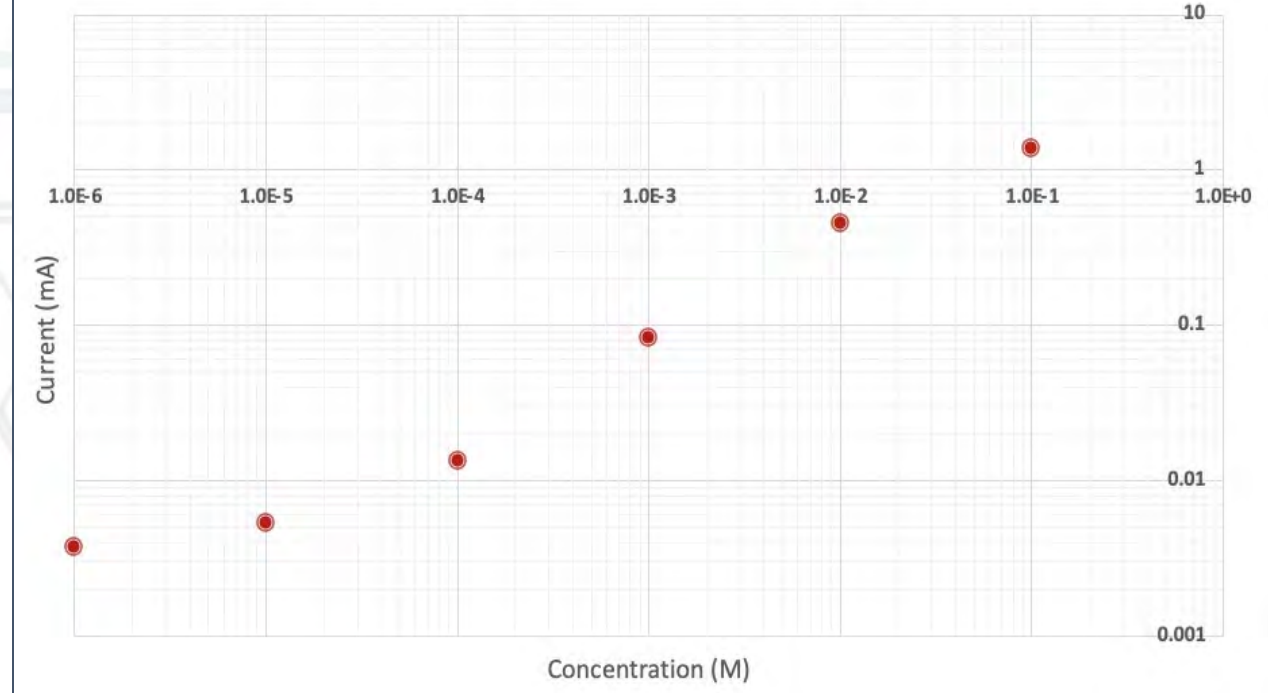


Figure 5: Cyclic voltammetry results after sweep from 0.5 V to 1.5 V

# Results continued

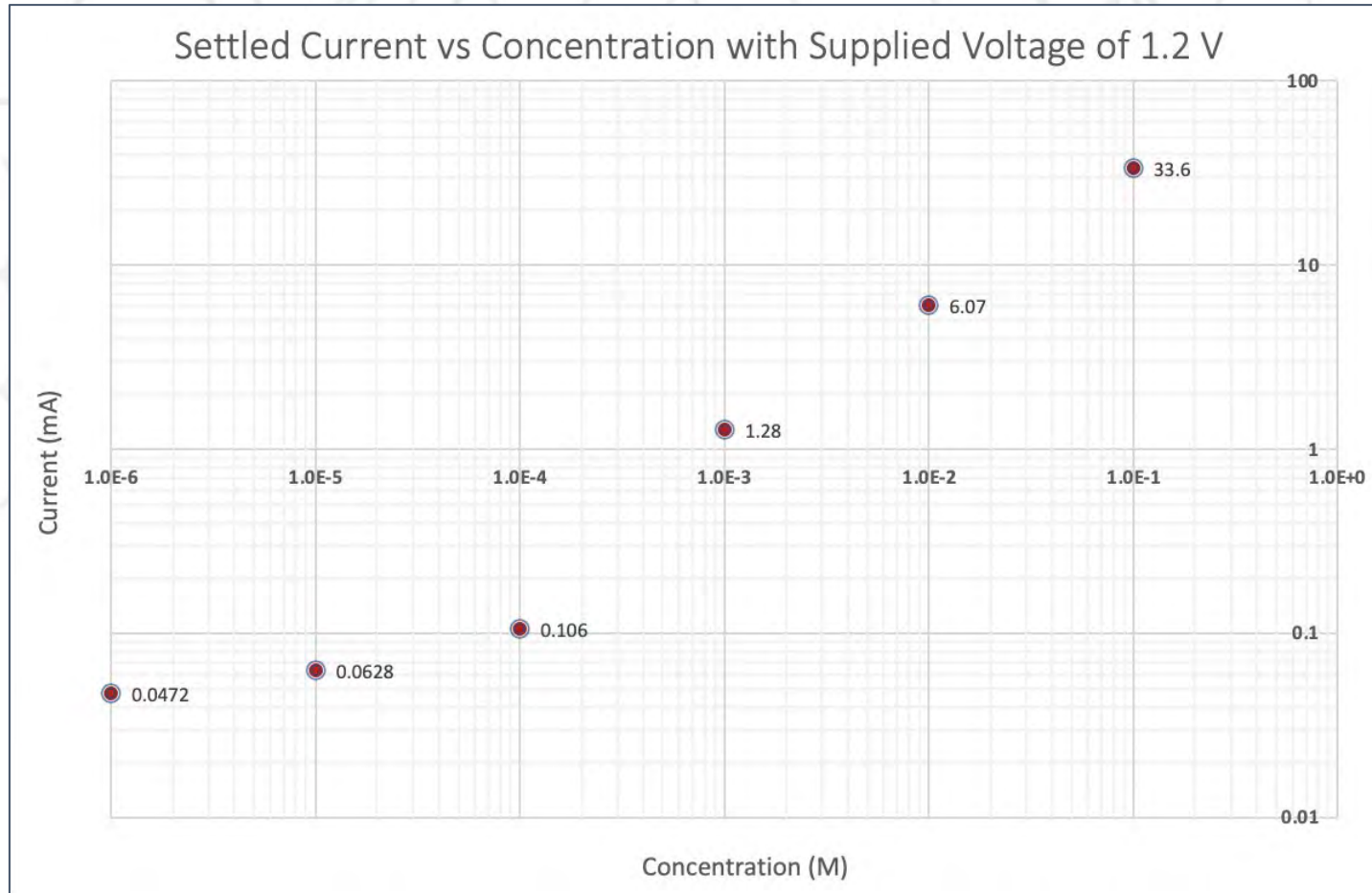


Figure 6: Chronoamperometry results

Sensitivity:

- 0.8179 dec/dec

Limit of detection:

- 1e-4 M

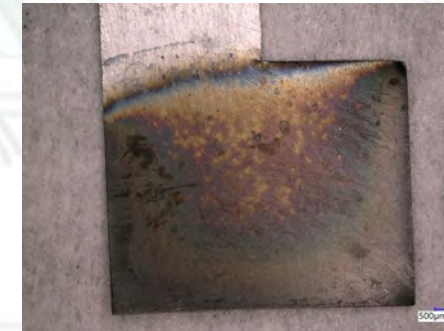


Figure 4: Mo electrode in 1e-1 M PBS after voltage of 1.2 V applied



Figure 5: Au electrode in 1e-1 M PBS after voltage of 1.2 V applied

# Summary

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The feasibility of a phosphate sensor composed of transient materials has now been confirmed, and further research can be conducted in regard to:

- miniaturizing the sensor
- converting electric current into signals
- constructing packaging out of biodegradable materials

