

Electrochemical Sensor Development for Manganese Ion Detection in Water Based on Glassy Carbon Electrode

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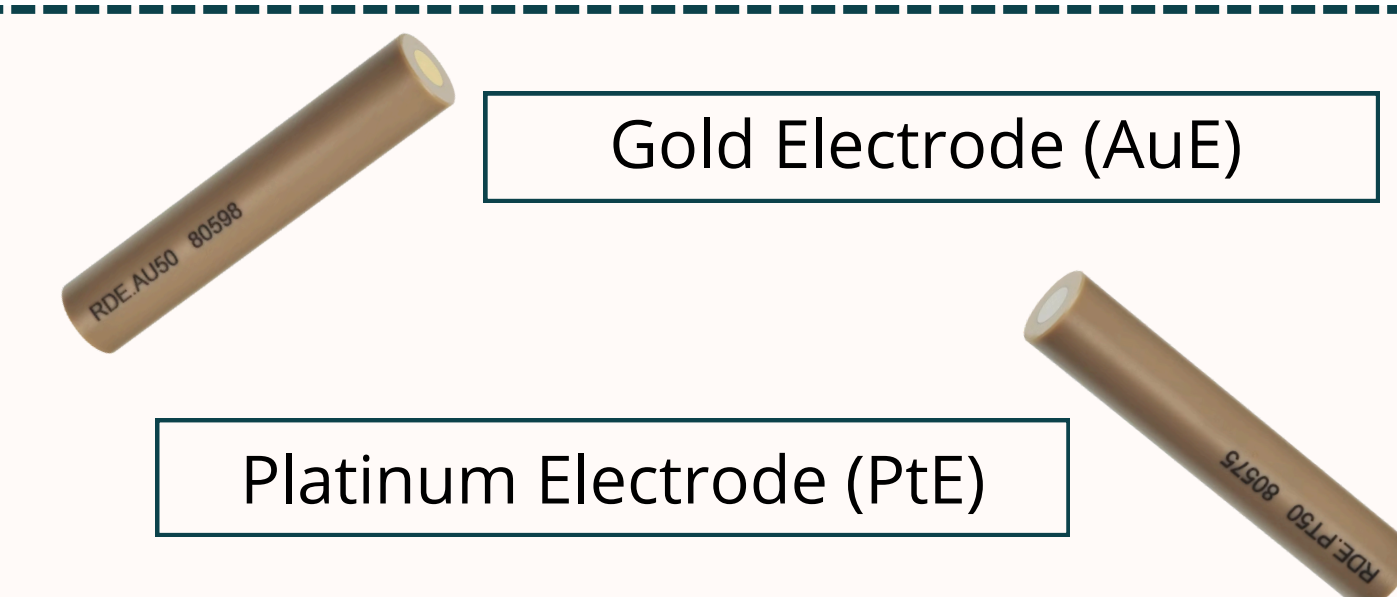
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PROBLEM STATEMENT

Excess exposure of Mn^{2+}

- Can build up in bone tissue up to 10 years³
- Can cause Parkinson-like syndrome²

Limitations of commonly used electrodes



Require **high cost**, **complicated electrode modifications** and **limited potential ranges**¹

0.1 mg/L

ACCEPTED level of Mn^{2+}

in drinking water & fresh water
(WHO Guidelines for Drinking Water Quality 1993/96)
(National Quality Standards for Malaysia)

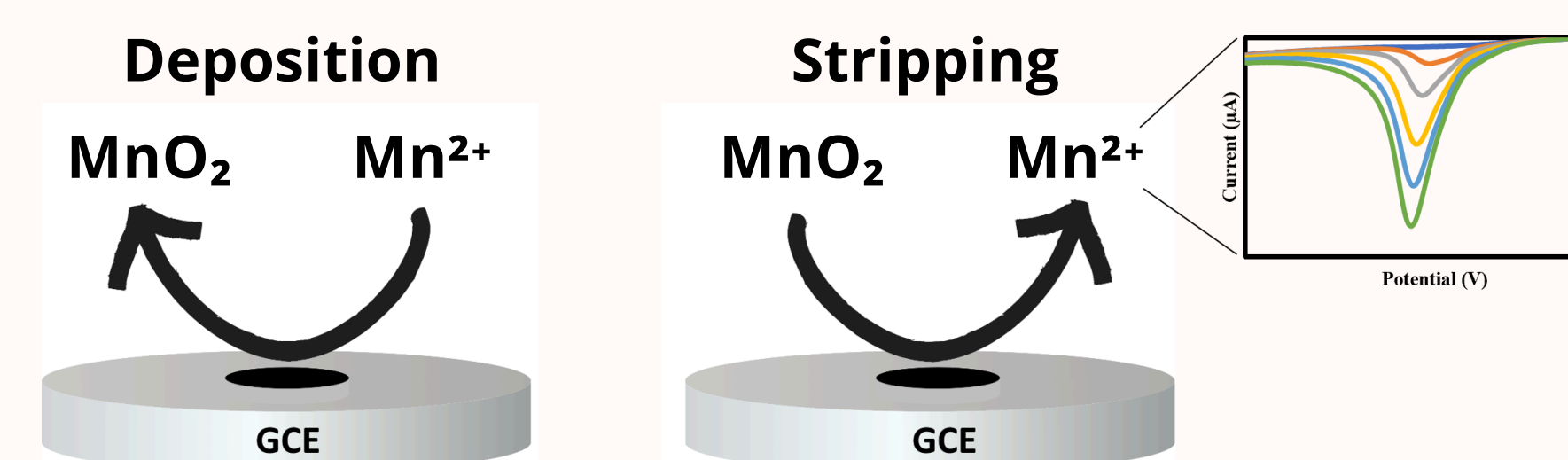
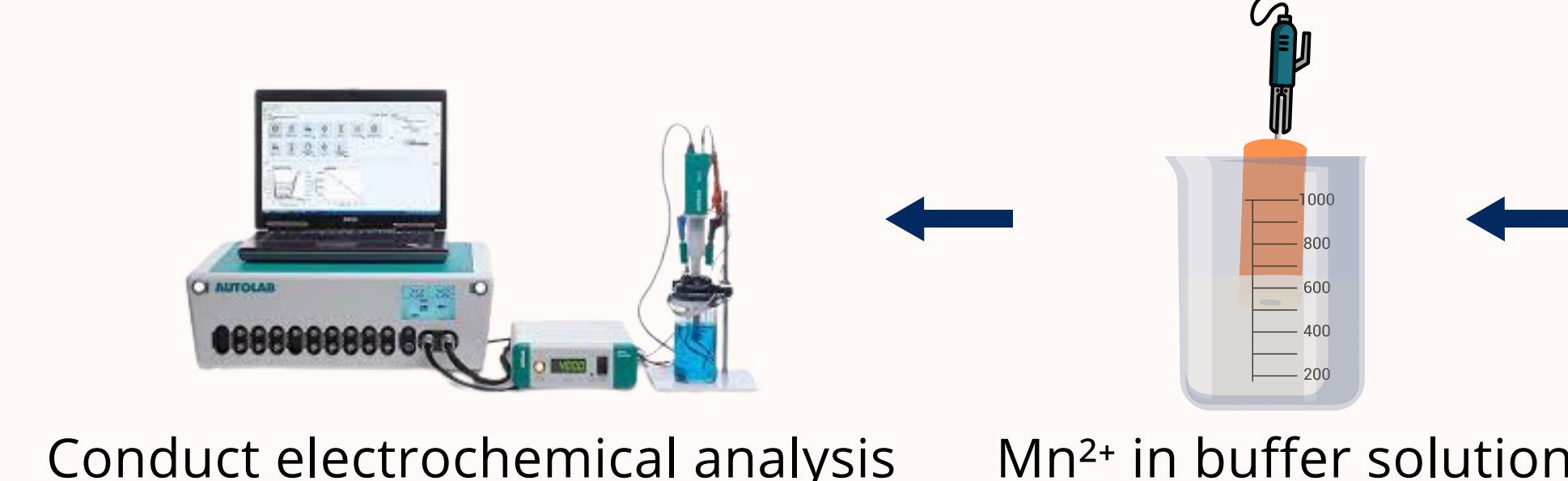
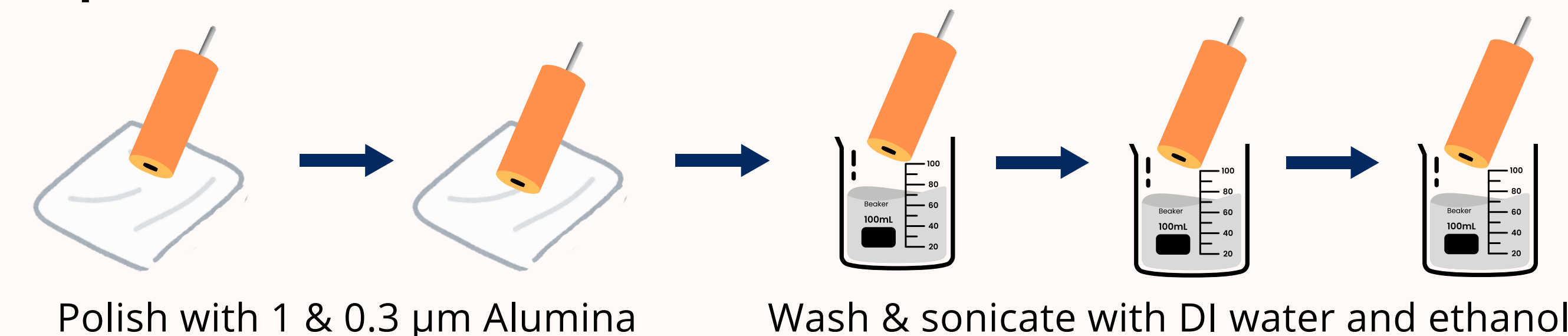
AIM OF STUDY

Develop an electrochemical sensor using a Glassy Carbon Electrode (GCE) as a preliminary study for a sensitive and selective Mn^{2+} detection in water



METHODS

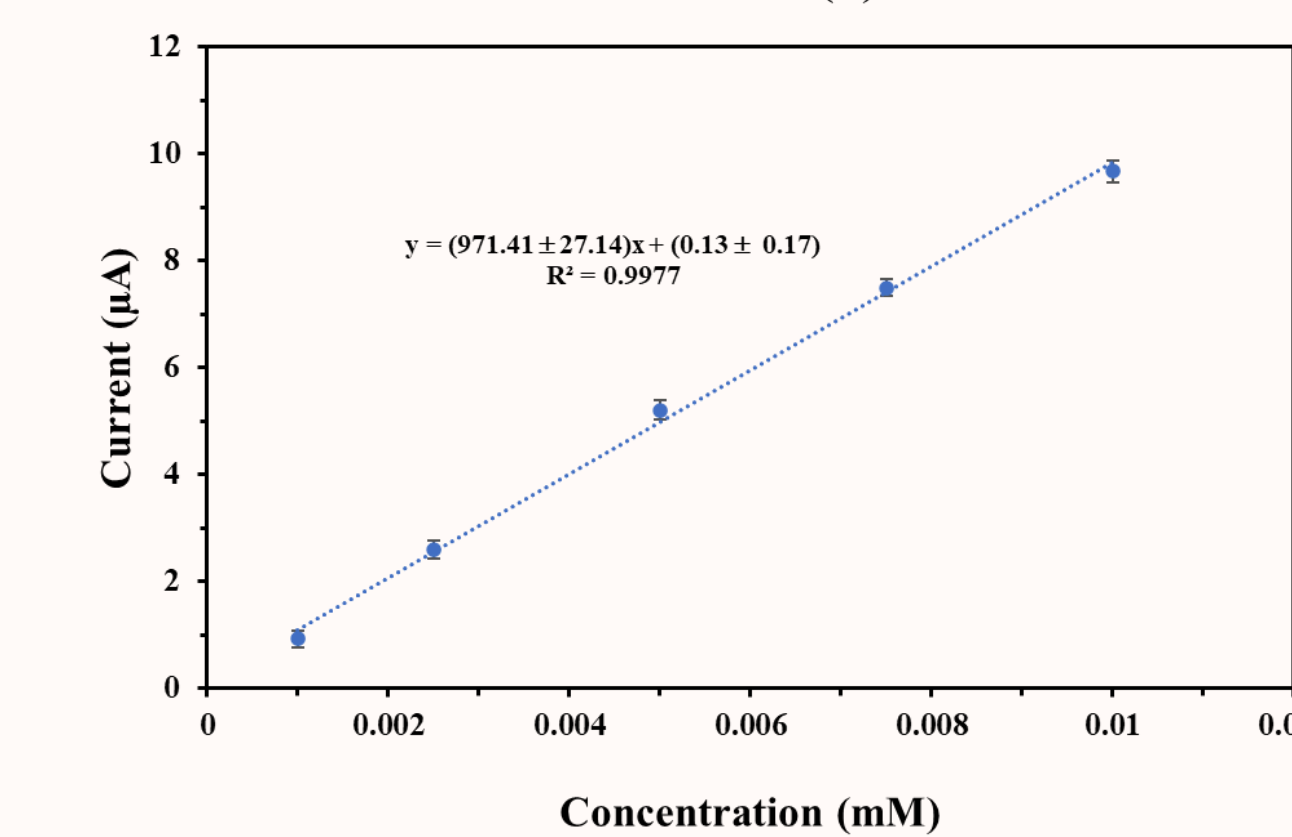
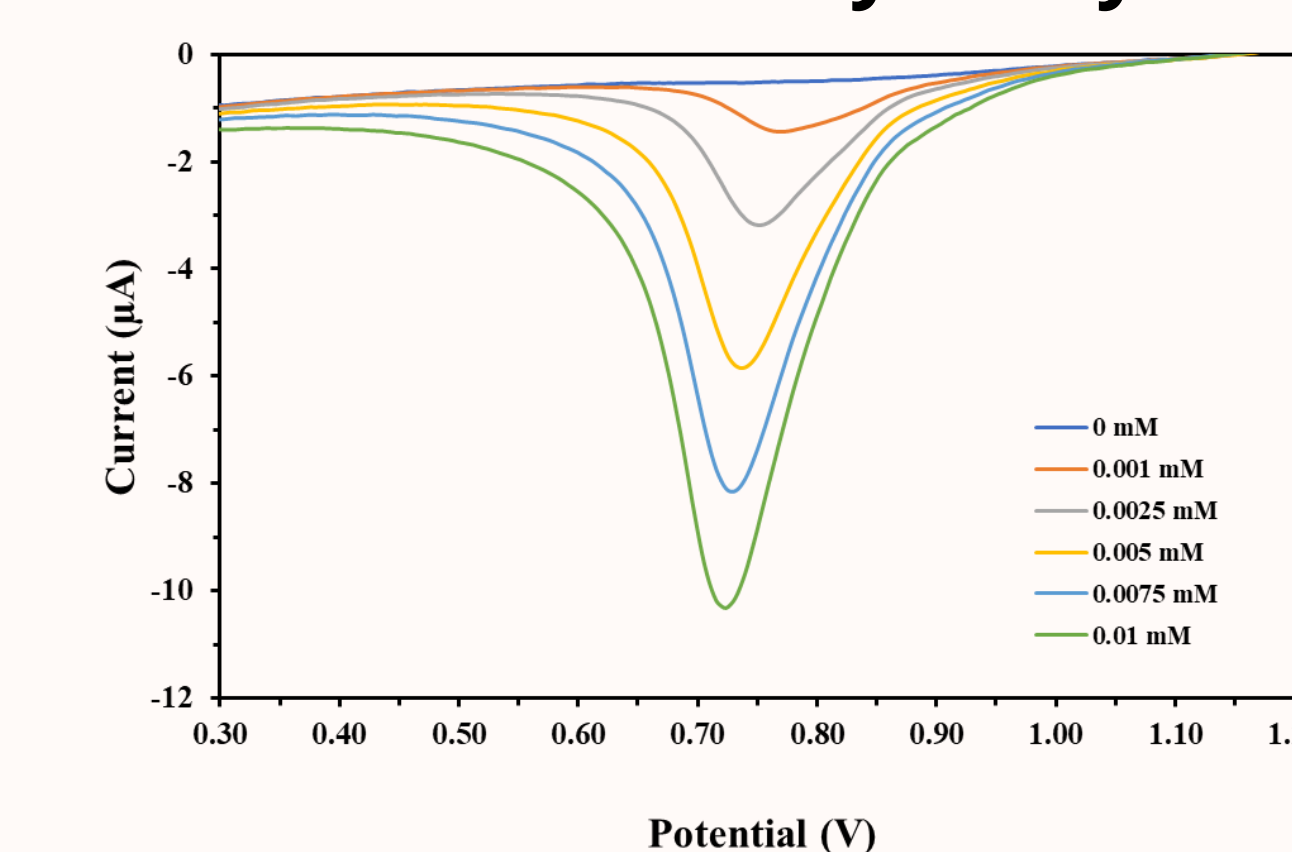
Preparation of GCE



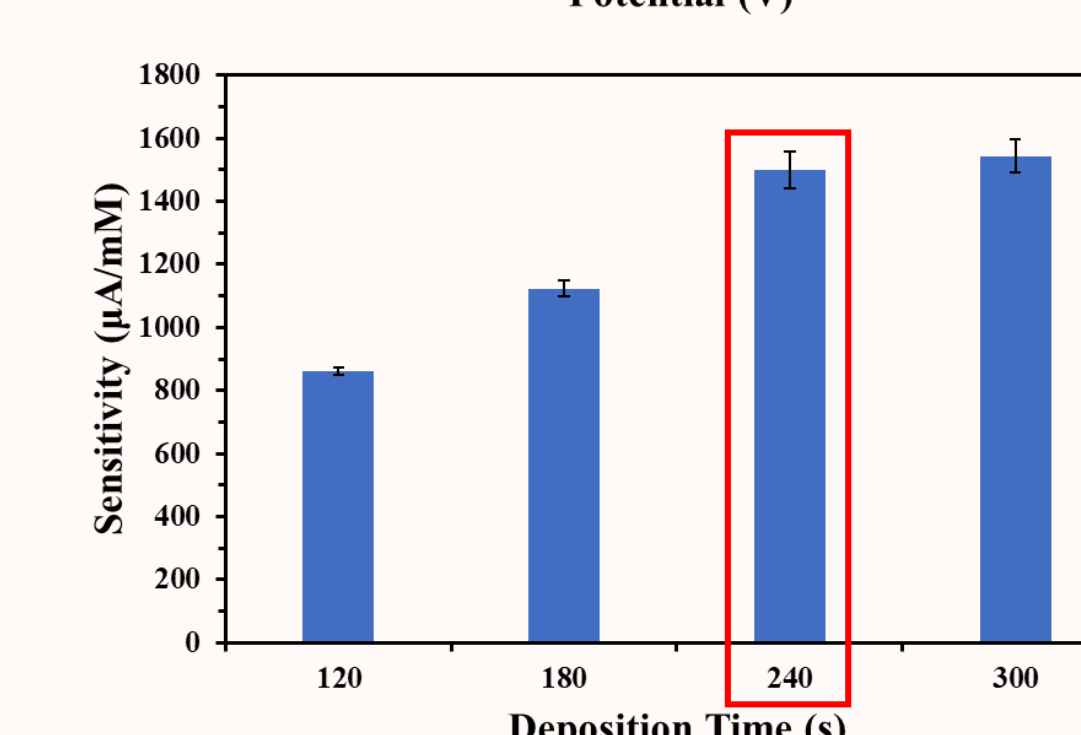
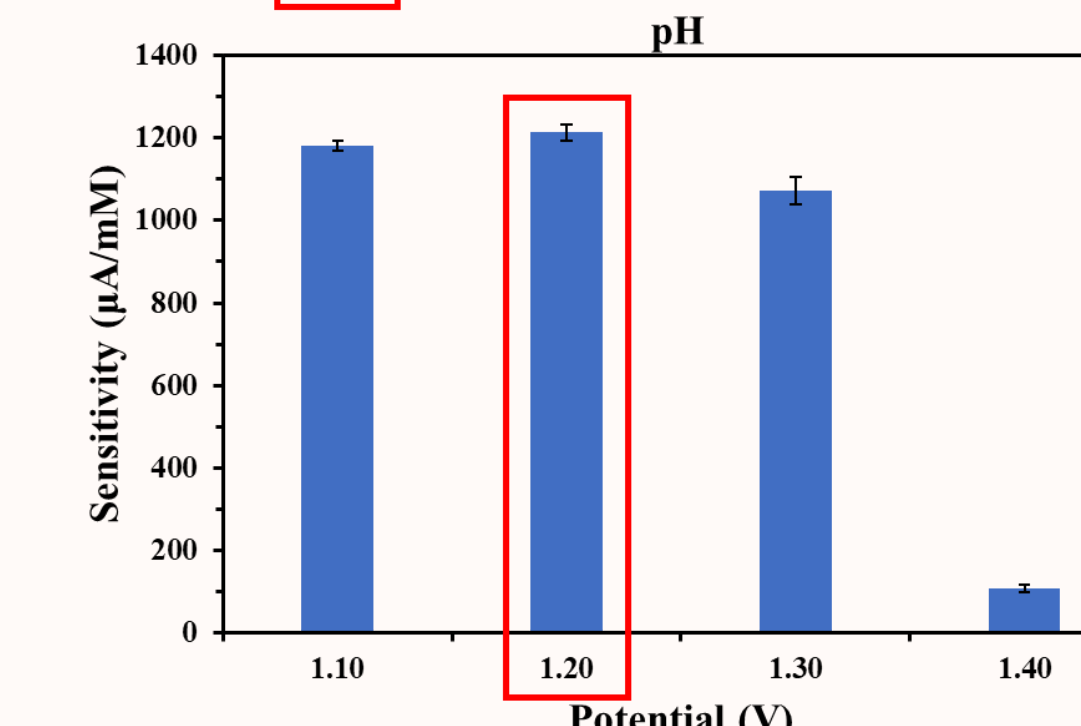
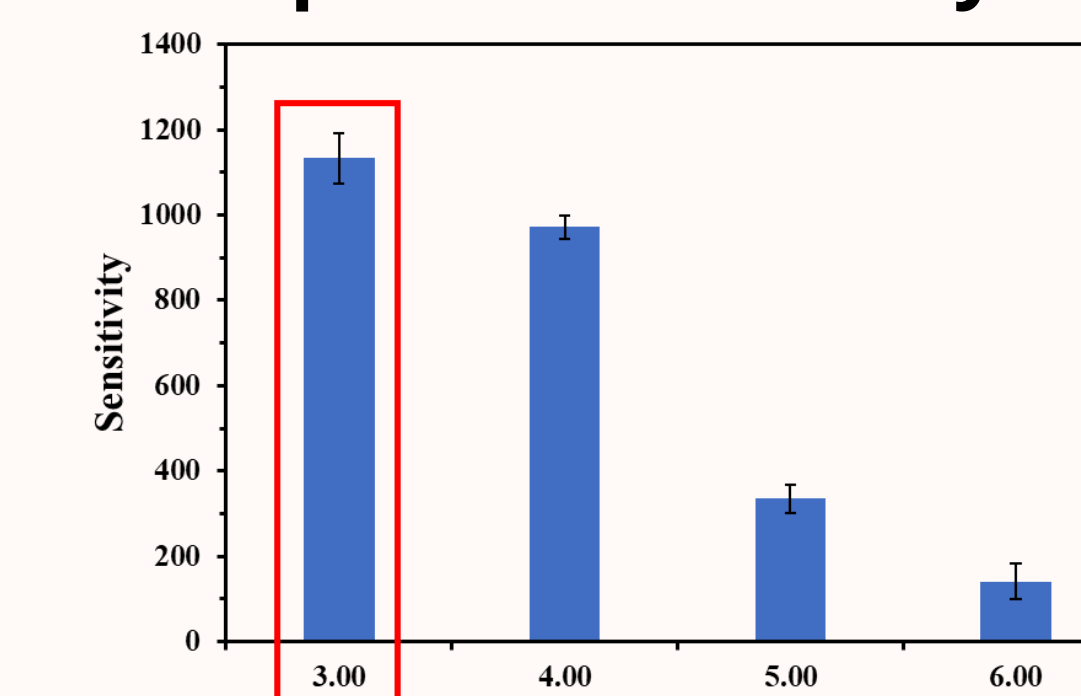
Schematic diagram of Mn^{2+} detection on GCE surface using Cathodic Stripping Voltammetry (CSV) analysis

RESULTS AND DISCUSSION

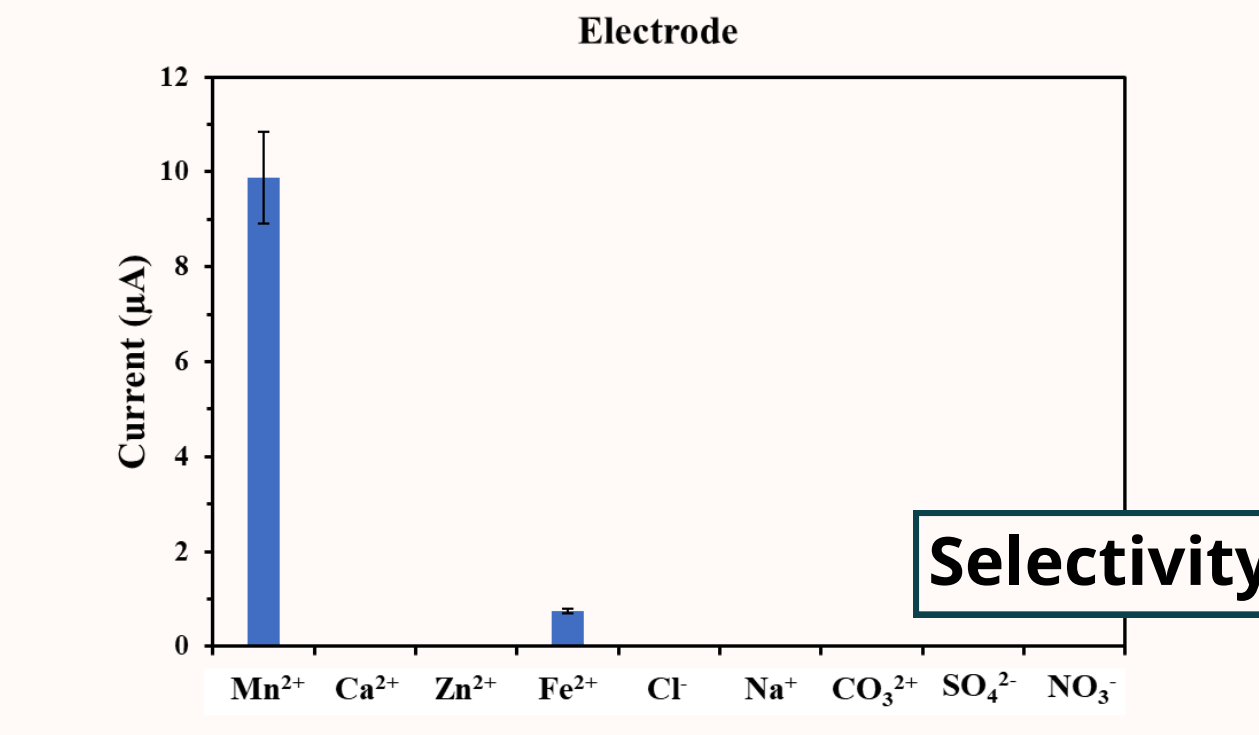
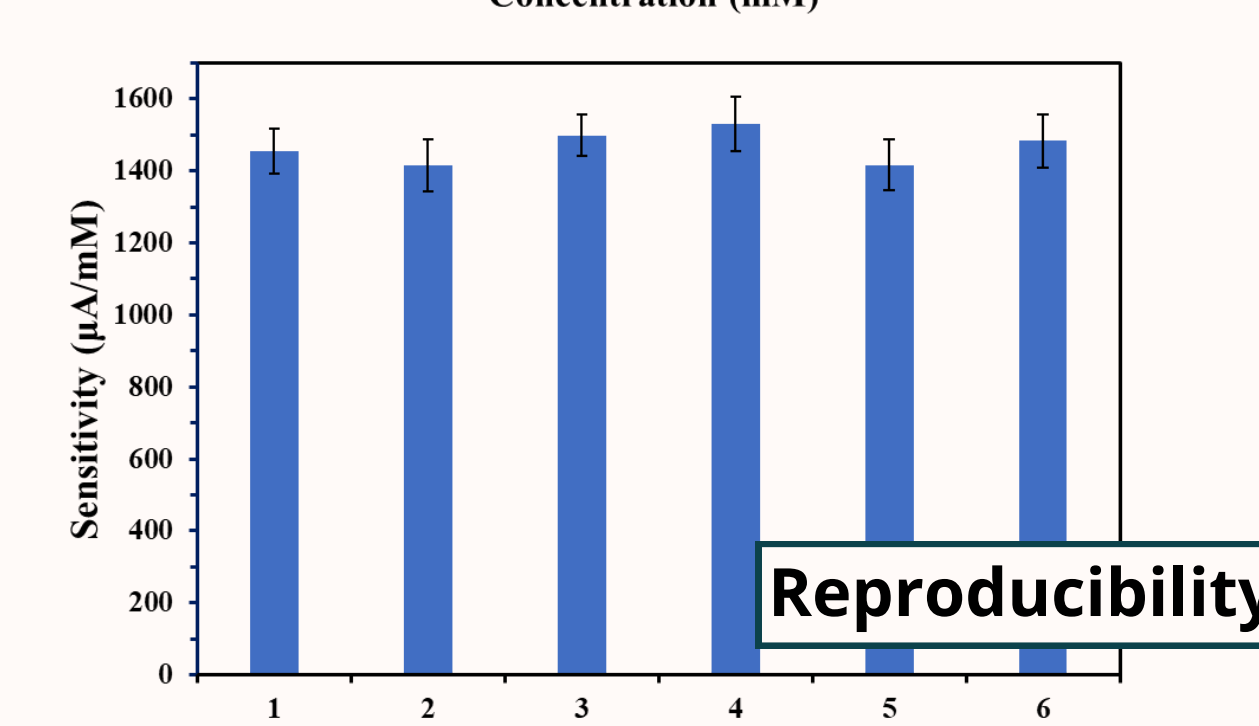
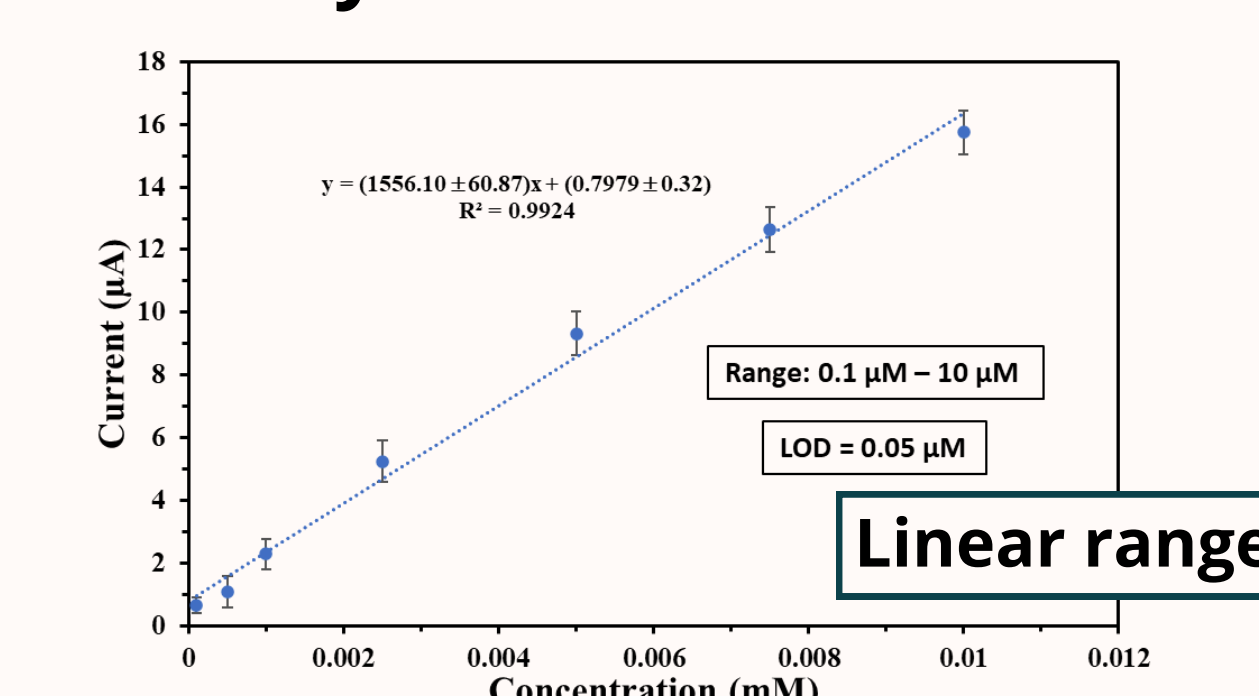
CSV Preliminary Analysis



Optimization Study



Analytical Performance



ALIGNMENT WITH SDG 6 (CLEAN WATER AND SANITATION)

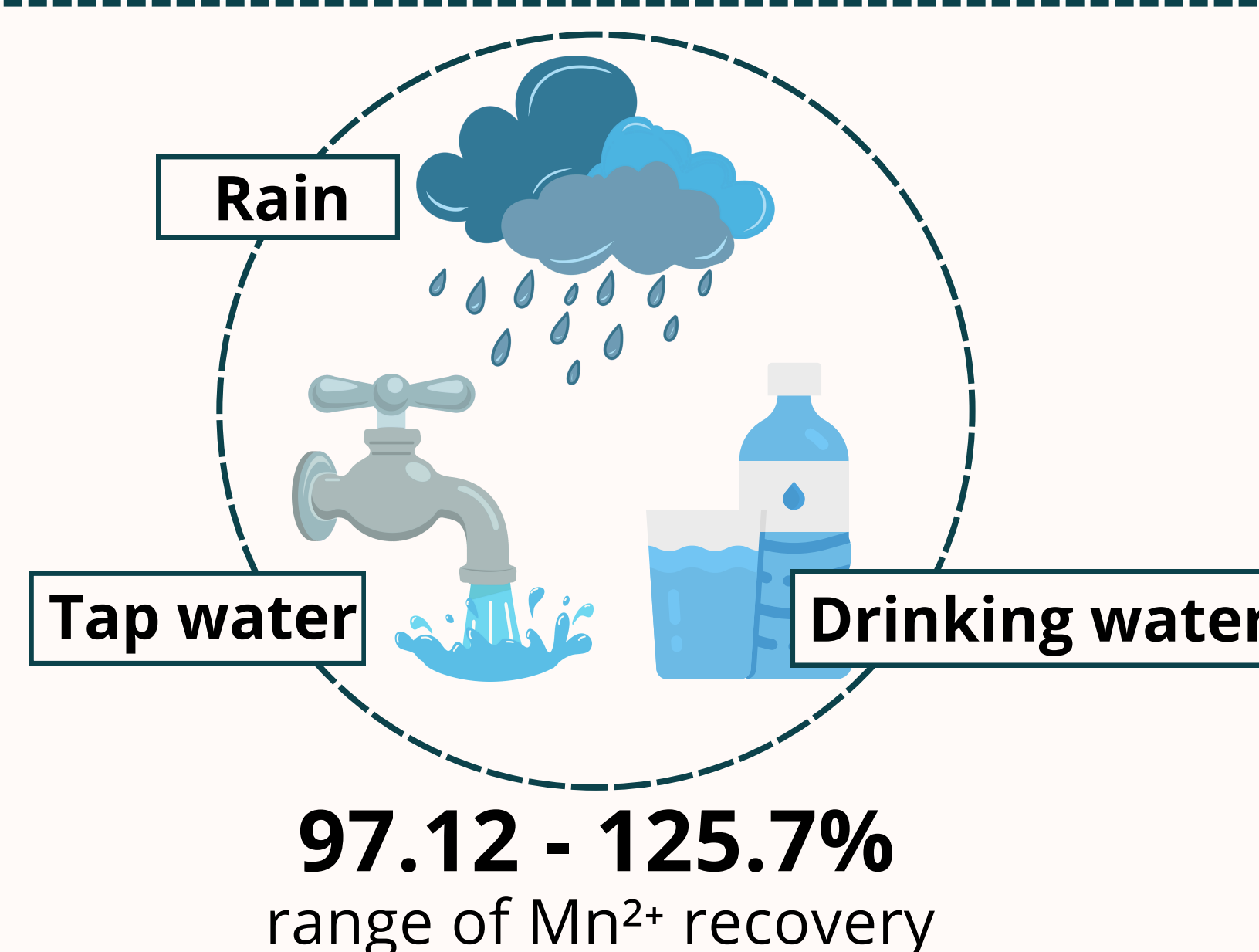
Enhancing Water Quality and Public Health:

- This research supports SDG 6 by developing a sensitive electrochemical sensor for detecting manganese ions, which is vital for ensuring safe drinking water (**Target 6.1**).
- By enabling accurate monitoring and preventing metal contamination, the sensor contributes to improving water quality and protecting public health (**Target 6.3**).⁴

Accessible Water Management Solutions:

- The sensor's simplicity promotes widespread adoption, especially in regions facing significant water quality challenges. This aligns with SDG 6's goals of sustainable water management and equitable access to clean water, supporting efforts to provide safe and affordable drinking water for all.

REAL SAMPLE ANALYSIS



97.12 - 125.7%
range of Mn^{2+} recovery

CONCLUSION

- ✓ **0.1 µM** Wide linear range **10 µM**
- ✓ **0.05 µM** Low LOD
- ✓ **6.33 - 10.39 %** Good reproducibility
- ✓ **97.12 - 125.7 %** Good recovery range
- ✓ Can be applied to detect Mn^{2+} in real water samples

FUTURE WORK

Develop **portable electrochemical sensing devices** for on-site analysis

Improve **electrode modifications** for higher sensitivity

ACKNOWLEDGEMENT

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REFERENCES

- <https://chem.libretexts.org/>
- Li, Q., & He, Y. (2017). An ultrasensitive chemiluminescence sensor for sub-nanomolar detection of manganese(II) ions in mineral water using modified gold nanoparticles. *Sensors and Actuators, B: Chemical*, 243, 454-459.
- Rakhtshah, J., Shirkhanloo, H., & Dehghani Mobarake, M. (2022). Simultaneously speciation and determination of manganese (II) and (VII) ions in water, food, and vegetable samples based on immobilization of N-acetylcysteine on multi-walled carbon nanotubes. *Food Chemistry*, 389.
- United Nations. (n.d.). Goal 6 | Department of Economic and Social Affairs. https://sdgs.un.org/goals/goal6#targets_and_indicators