

THE DEVELOPMENT OF A RASPBERRY-PI BASED COLOURIMETER FOR HIGH THROUGHPUT ANALYSIS OF PLANT NUTRIENTS IN WATER AND SOIL UTILISING ZEOLITE-MODIFIED OPTICAL SENSORS

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INTRODUCTION

- Raspberry-Pi based Digital Colourimeter
- Ionophore based optical sensor (optodes)
- Possibility of using zeolites instead of traditional ion-exchangers



EXPERIMENTAL

- The selective optode membranes were prepared using the following chemicals: chromoionophore II, ion exchanger KTpClPB (or NaX), potassium ionophore I (valinomycin), PVC, and DOS.



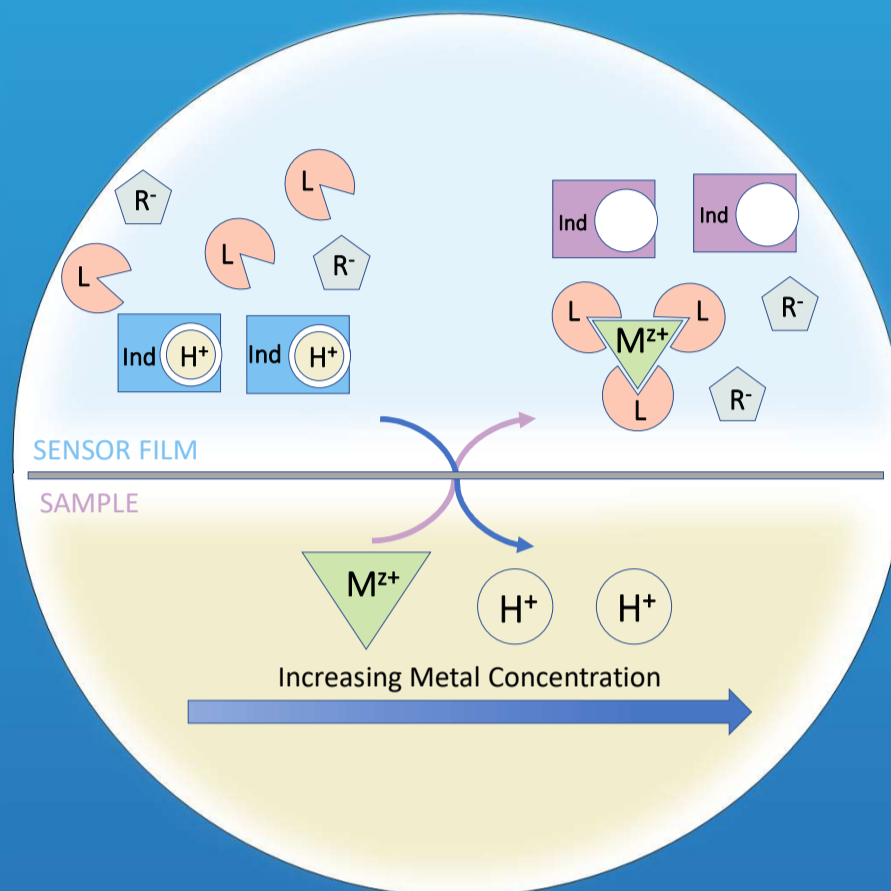
RESULTS

- Optodes are based on bulk extraction equilibria into a hydrophobic water-immiscible film
- An optical signal is typically enabled by the presence of a secondary ionophore (chromoionophore)
- Calibration of PiSENS was performed by using fully protonated and fully deprotonated optodes as boundary conditions required by our very own python code

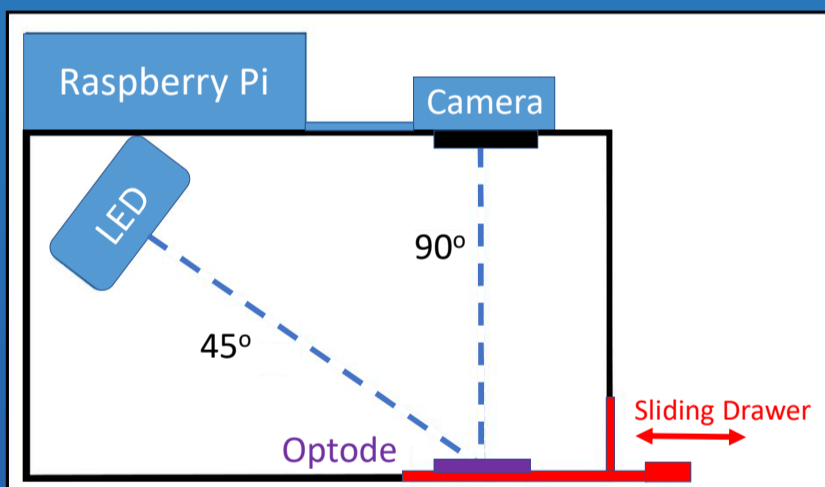


CONCLUSIONS

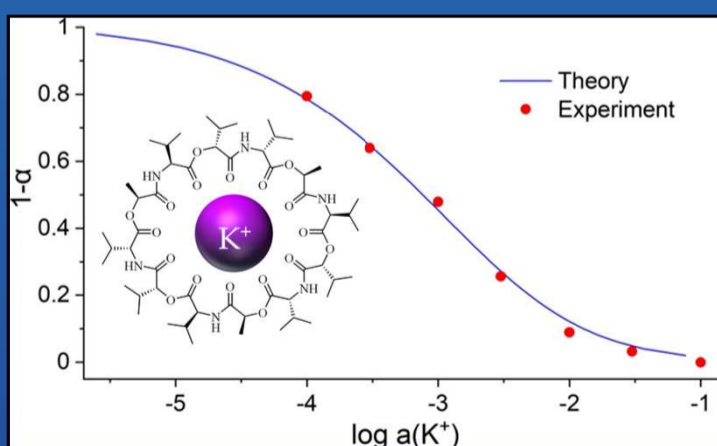
- Inexpensive, portable, and easy-to-use digital colourimeter with high spatiotemporal resolution
- Replacing the common ion exchanger with zeolites requires improvement in sensor design and composition



Schematic representation of the ion-exchange process triggered upon the increase of the analyte ion concentration. Where R is the ion-exchanger, L is the ionophore and Ind is the chromoionophore.

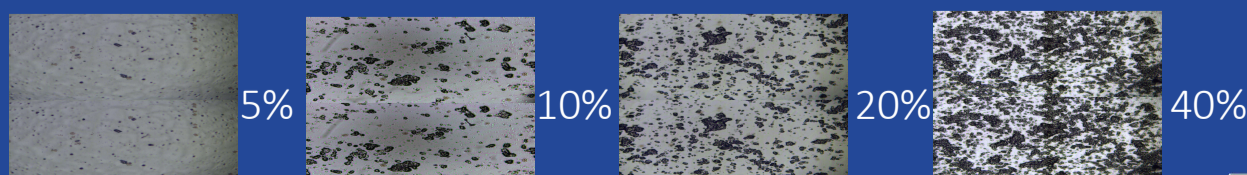
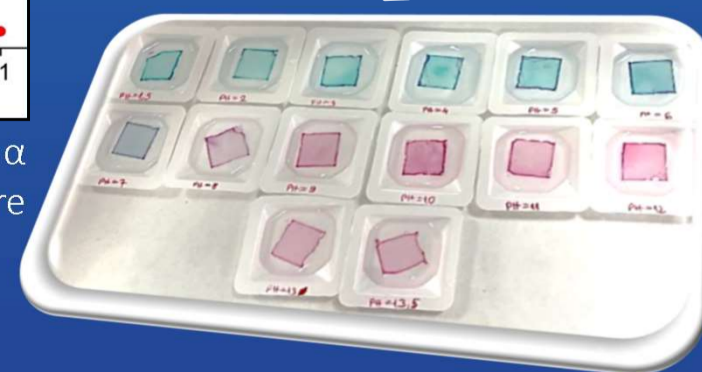


The optode is securely placed on a drawer that can be slid into the 3D-printed box. Within the box, a diffusive LED is placed to shine the light at a 45° angle to the optode. Raspberry Pi's camera is placed on top of the box with its lens protruding into the box at a 90° angle to the optode.



Calibration curve of K⁺ in water samples, α is dissociation constant and the structure is of valinomycin ionophore.

Using an in-house spin-coating device (3,500 rpm) an aliquot (~60 μ L) of the "cocktail" was cast onto cover glass pieces (18mm x18mm).



Several sensors with different wt% of NaX zeolite have been made instead of commonly used ion exchangers (close-up microscopic pictures of zeolites inside optodes)

