Non-invasive Electrochemical Detection of Glucose using CuO-NiO/MXene Modified Electrode

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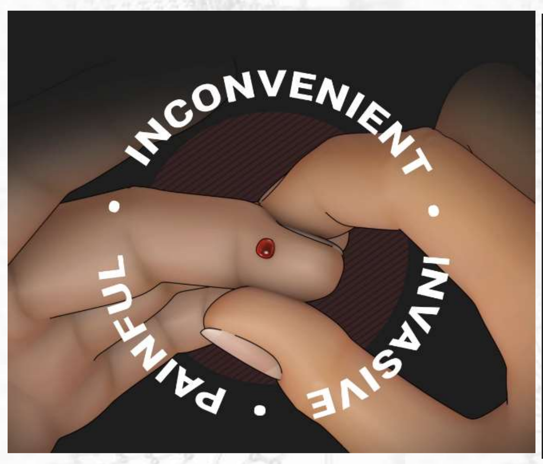
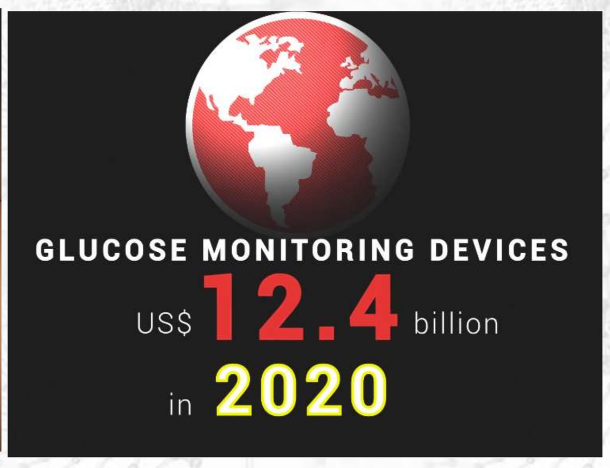
ABSTRACT

High levels of glucose or acetone in breath confirms diabetes disease. One of the analytical devices that detect changes in breath is the electrochemical sensor having high selectivity, easy to use and being able to meet diabetic patient's needs. In this study sensors were made by fabricating metal oxide coated glassy carbon electrodes and using nafion as a proton conductor. Characterization methods such as X-ray diffraction, FTIR and morphological analysis have been performed for metal oxides to characterize their atomic arrangement and composition. Also, electrochemical studies were done using Gamry instrument and curves plotted as current in amperes versus voltage to test the coated electrodes conductivity. High selectivity sensors provide promising applications in any field.

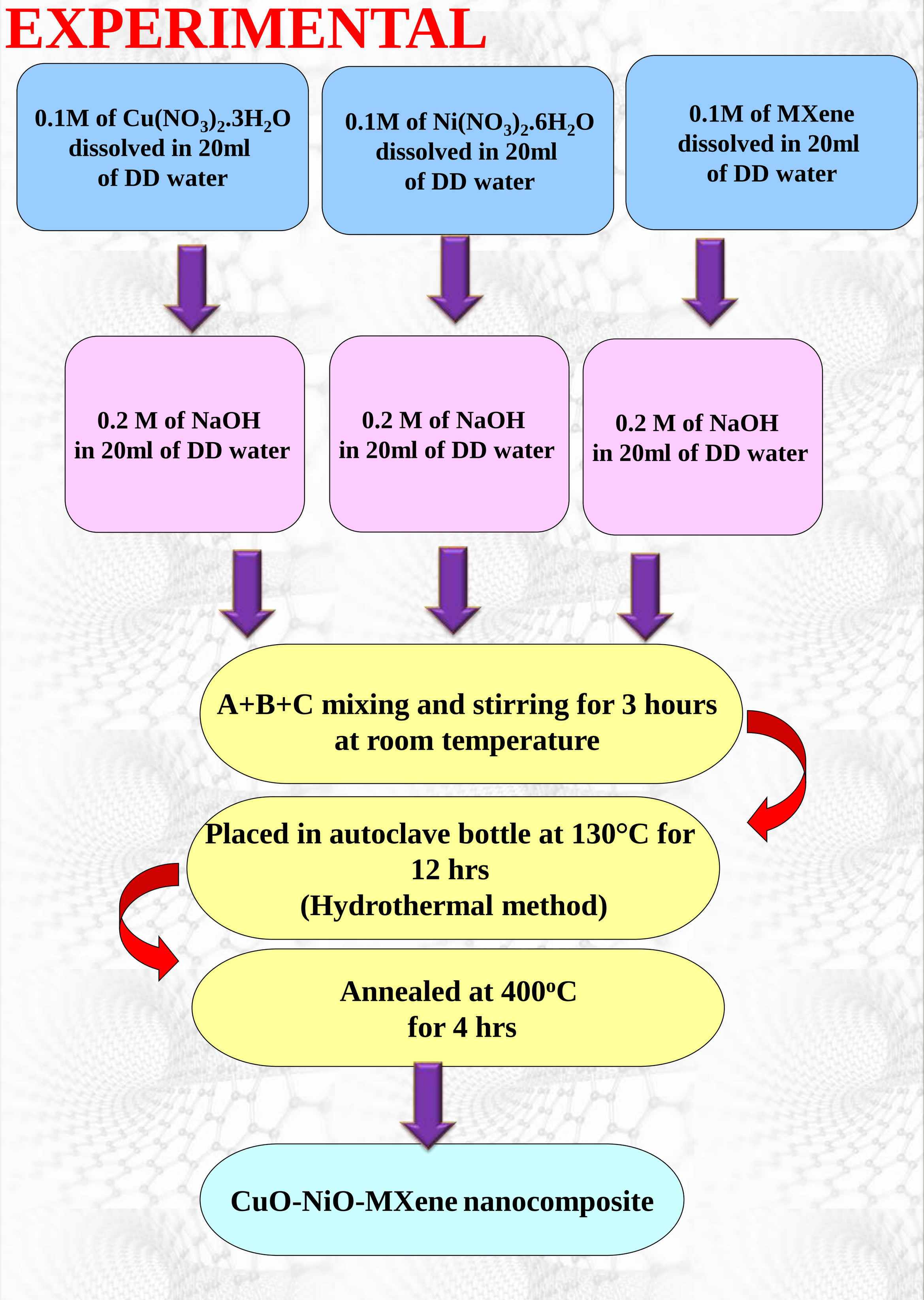
INTRODUCTION

- Sensor is an analytical device that detect changes in the environment by measuring concentration of specific substances.
- It is designed as wearable, flexible and stretchable electronic devices.
- Continuous monitoring of glucose can be advantageous to diabetic patients.
- High sensitivity to glucose is important for good detection.
- In this study, glucose is detected by electrochemical method by fabricating metal oxide coated glassy carbon electrodes.
- Metal oxide nanocomposite of CuO-NiO/MXene



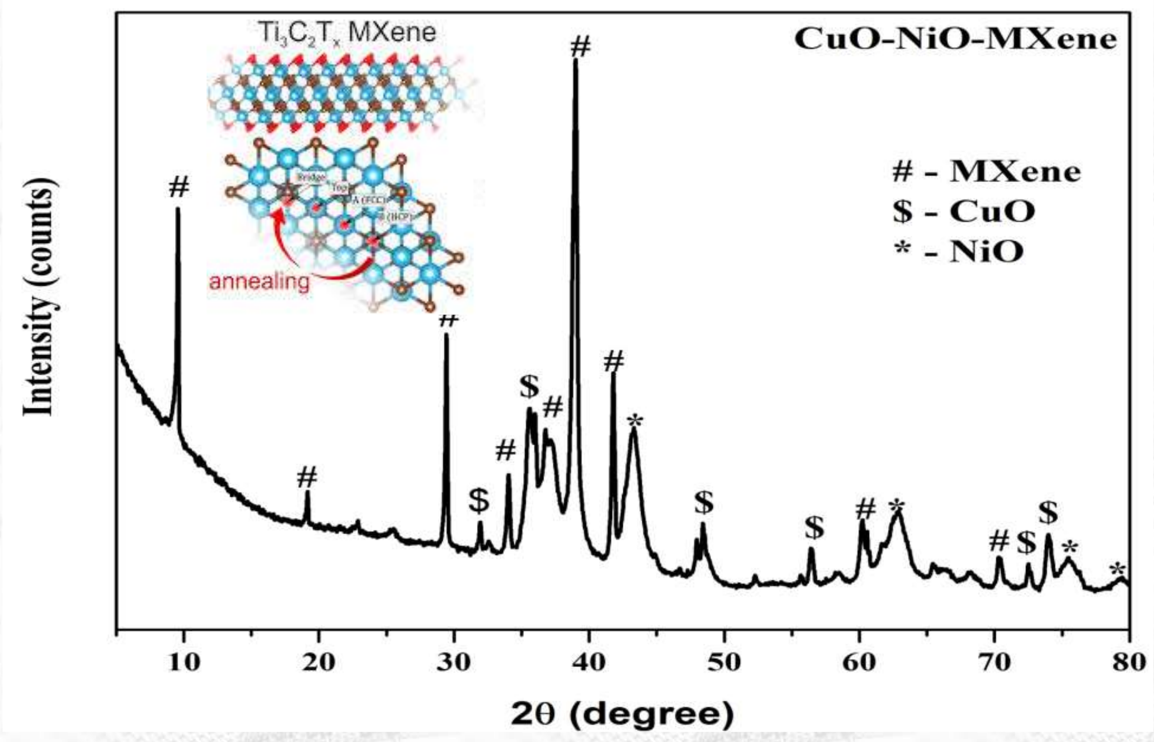


EXPERIMENTAL



RESULTS & DISCUSSION

X-ray diffraction

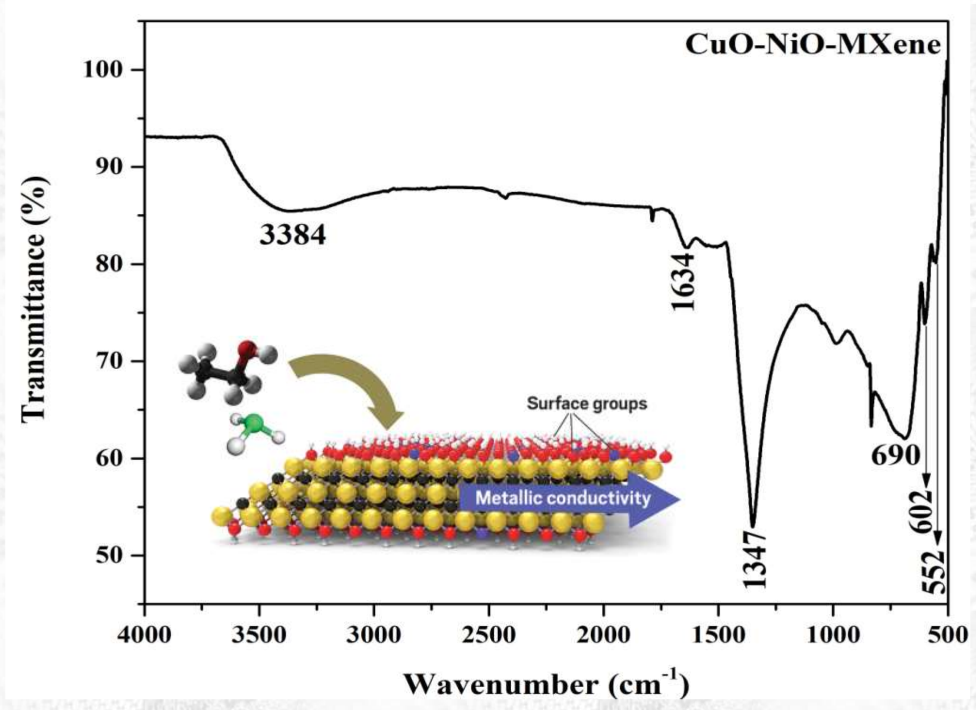


X-ray diffraction graph of CuO-NiO/MXene

Sample	Phase	Lattice parameter (nm)	Strain(ε) x10^{-3}	Crystallite size (nm)	Dislocation density (δ) x 10^{14} (lines/m^2)
CuO-NiO-MXene	CuO (Monoclinic)	a=0.4685 b= 0.3420 c= 0.5132	2.86	28.08	12.7
	NiO (cubic)	a=b=c=0.4216	7.37	47.02	4.53
	MXene (Hexagonal)	a=b=0.3061 c=0.1864	1.89	18.33	29.8

Lattice parameters obtained from CuO-NiO-MXene nanocomposite

FTIR analysis

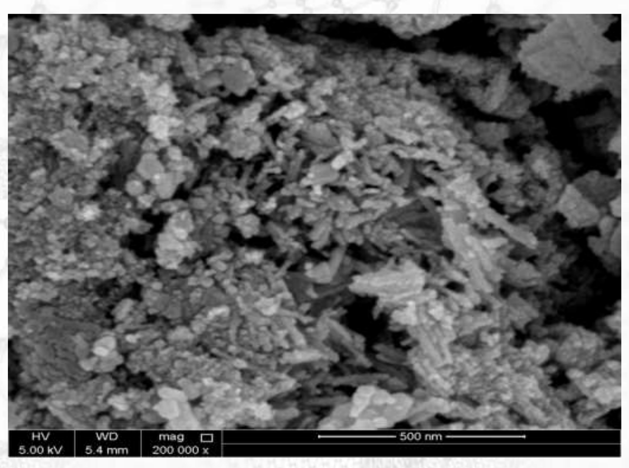


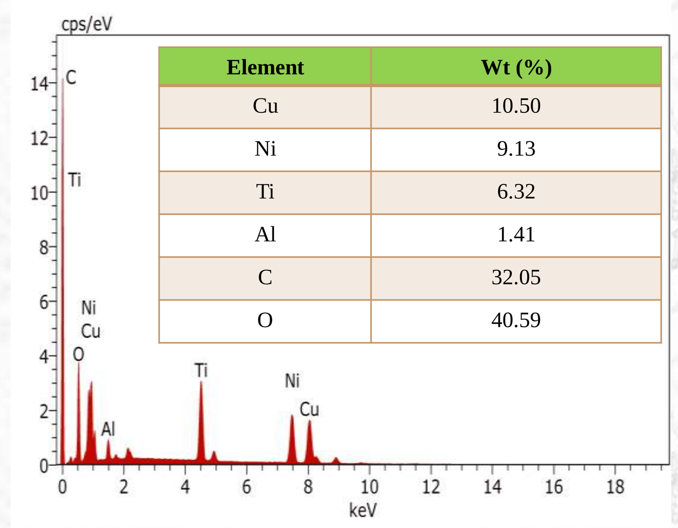
FTIR analysis of CuO-NiO-MXene

Band (cm^{-1})	Assignments
3384 and 1634	O-H stretching vibration
1347	CO_3^{2-} group
550-700	Cu-O, Ni-O, Ti-O stretching vibration

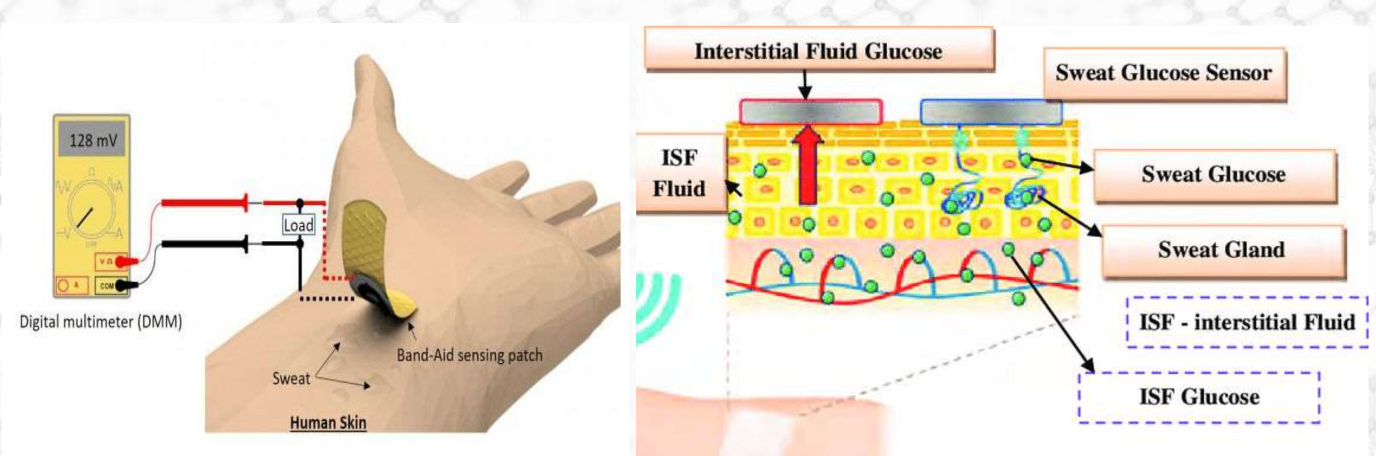
Hydrothermally prepared CuO-NiO-MXene nanocomposite

SEM (EDAX)

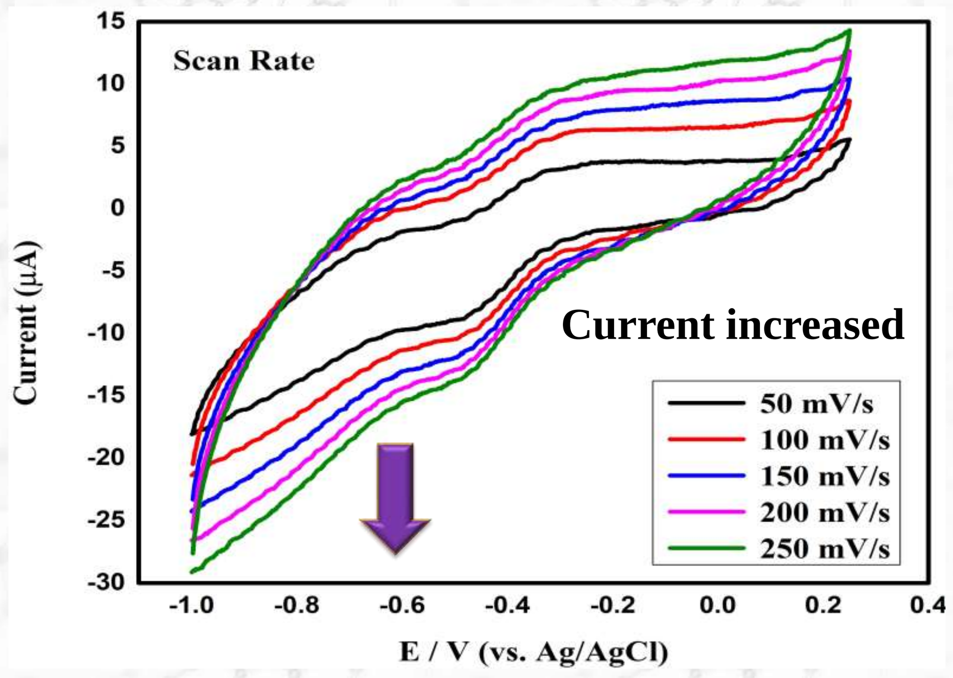




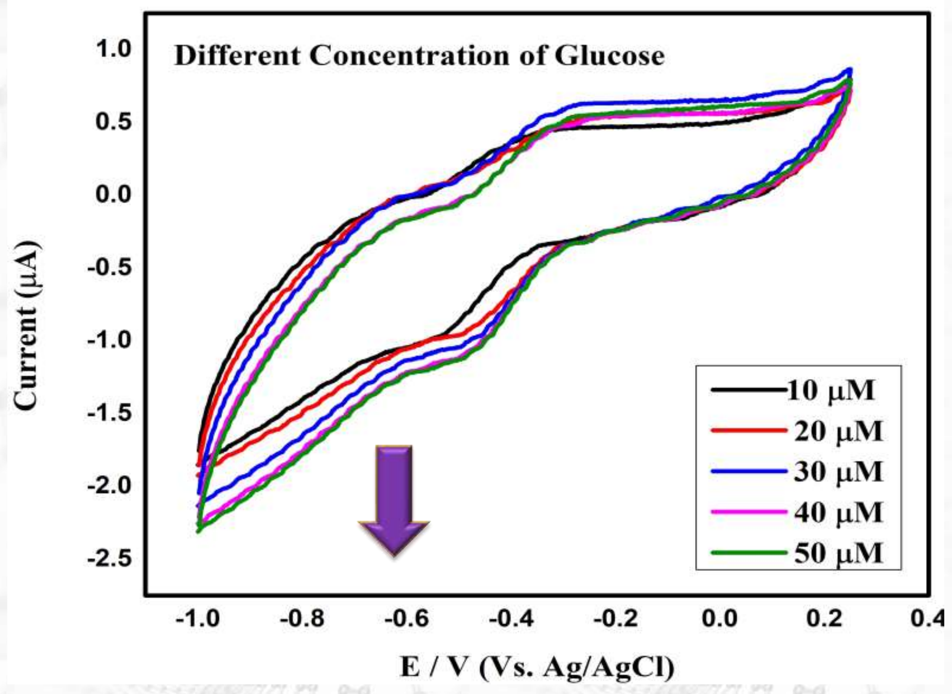
MECHANISM



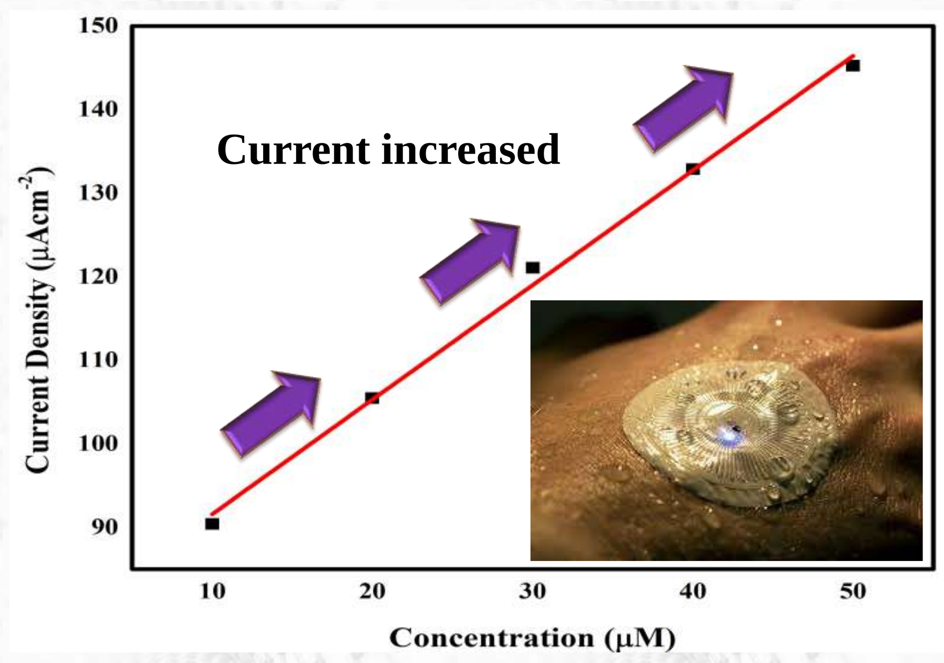
Electrochemical Studies



Modified electrode response for different scan rates



Modified electrode response for different glucose concentration



Current vs. Glucose concentration

CONCLUSION

- In conclusion, characterization methods were used to show if glucose sensors could function in highly stretched states demonstrating promising applications in real-world wearable biological diagnostics anytime and anywhere.
- The modified electrode shows a sensitivity of 1.37 μA cm^{-2} μM^{-1}
- Non-Invasive Glucose sensor development is important for diabetic patients.

BENEFITS TO QATAR

Electrochemical detection of nonenzyamtic glucose is very interest for biomedical diagnostics and for applications in health care products at Qatar hospitals.

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