Synthesis, characterization and biosensor applications of CuO-NiO nanocomposite

Sadiyah Shafath[1,2], Vinotha Krishnasamy[2], Karthik Kannan[2], John-John Cabibihan[3] , Abdulaziz Khalid Al-Ali[4], Rayaz A. Malik[5], Kishor Kumar Sadasivuni[2*]

[1]*Department of Chemical Engineering, Qatar University, P.O. Box 2713, Doha, Qatar*

[2]*Centre for Advanced Materials, Qatar University, P.O. Box 2713, Doha, Qatar*

[3]*Department of Mechanical and Industrial Engineering, Qatar University, P. O. Box 2713, Doha, Qatar*

[4]*Department of Computer Engineering, Qatar University, P.O. Box 2713, Doha, Qatar*

[5]*Weill Cornell Medicine, P.O. Box 2713, Doha, Qatar*

**Corresponding author: kishorkumars@qu.edu.qa*

INTRODUCTION

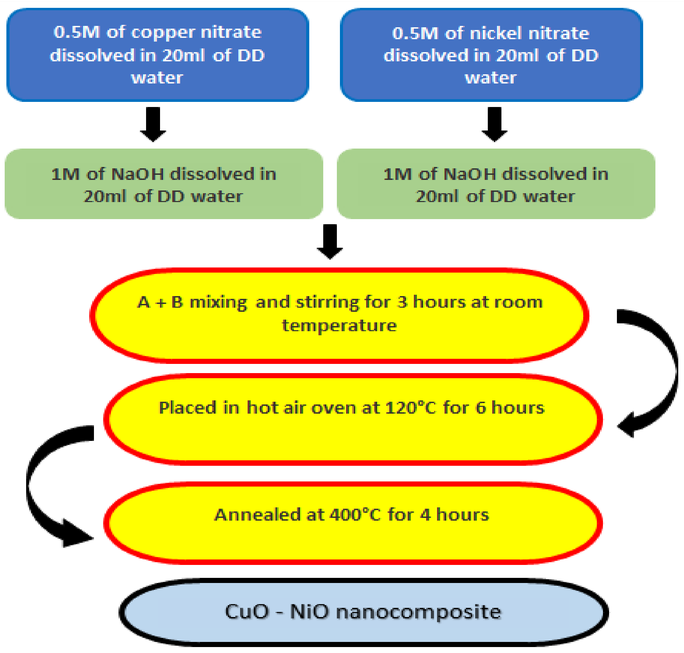
ABSTRACT

The effect of CuO-NiO nanocomposite was studied by addition of various concentrations of acetone. High acetone level in human breath is an indication of the diabetes. Studies were performed to determine the structure (XRD, Raman) and morphology (SEM with EDAX). The CV response of modified GCE with and without acetone was studied. It was observed that in the presence of acetone there is a reduction in current. These sensors show excellent flexibility and can used to fabricate the sensors to stick on the body.

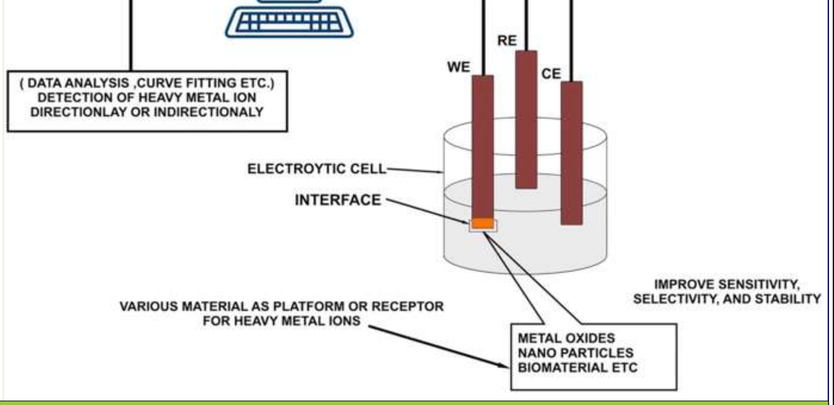
WHY *CuO — NiO* ?

- **Copper oxide (CuO)** possesses excellent electro-catalytic activity, has a controllable size, very good thermal conductivity and has high stability making it very attractive for the use of biosensors.
- **Nickel oxide (NiO)** is stable and has much better electro-catalytic property thus enhancing the intensity of the electrochemical and suitable for detection of the analyte at very low concentration levels.

SYNTHESIS OF *CuO — NiO*

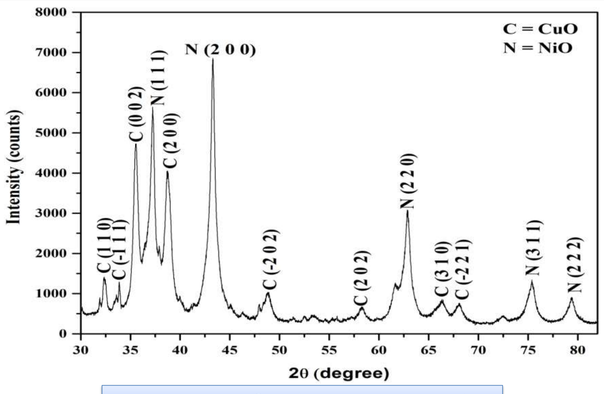


SCHEMATIC DIAGRAM OF PROCESS



RESULTS AND DISCUSSIONS

STRUCTURAL STUDIES

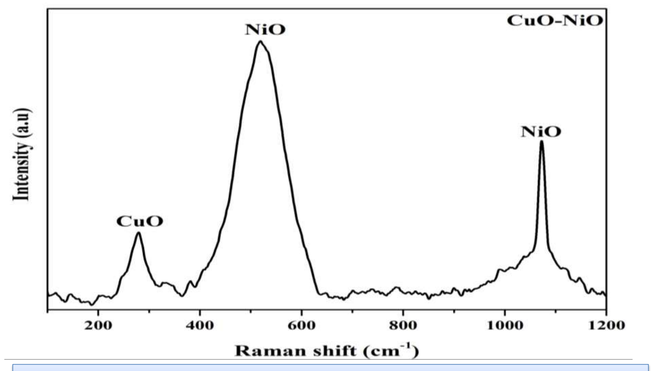


XRD pattern for the nanocomposite

Phase	Lattice parameter (nm)	Crystalline size (nm)	Dislocation density (lines/m^2)
CuO (Monoclinic)	a=0.4691 b=0.3418 c=0.5139	32.4	9.525×10^{14}
NiO (Cubic)	a=b=c=0.4218	18.5	2.923×10^{15}

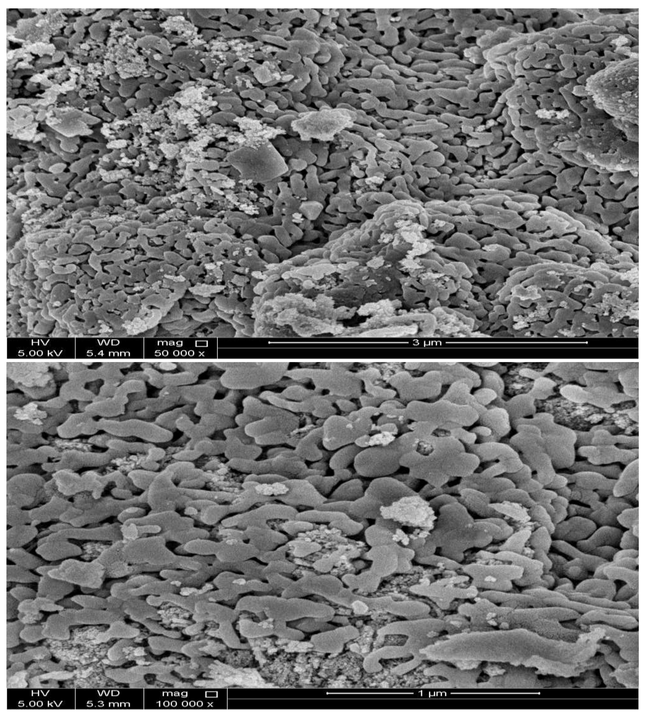
Physical Parameters

RAMAN STUDIES

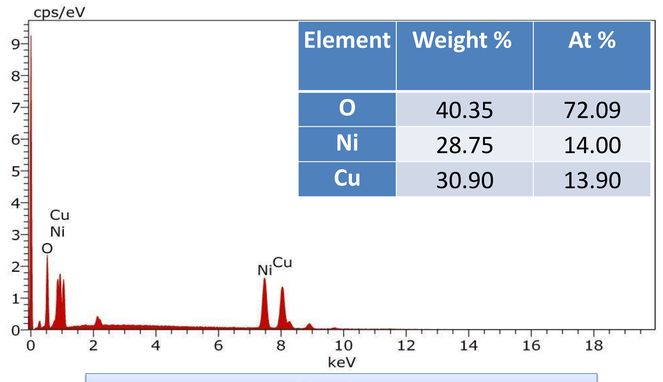


Raman spectrum for the nanocomposite

MORPHOLOGICAL STUDIES



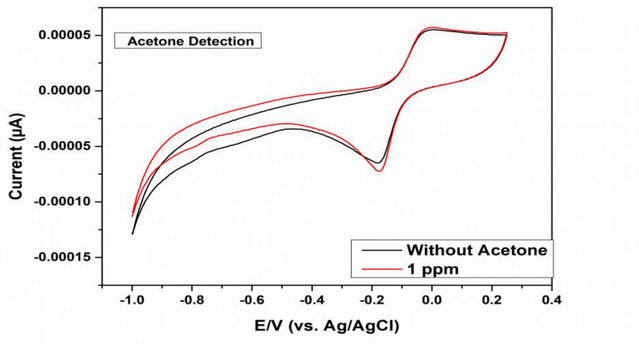
SEM images for the nanocomposite



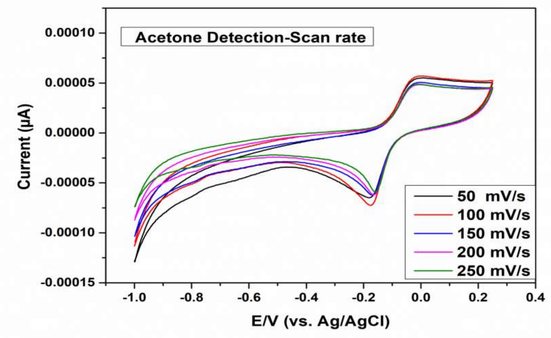
Element	Weight %	At %
O	40.35	72.09
Ni	28.75	14.00
Cu	30.90	13.90

EDAX pattern for the nanocomposite

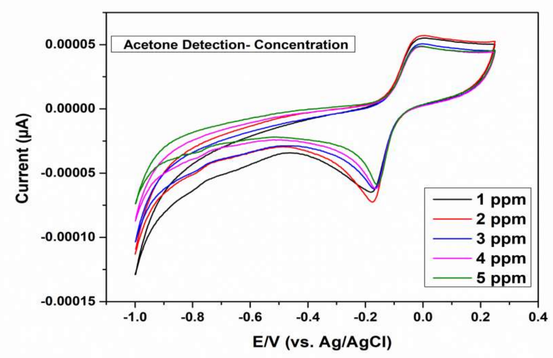
ELECTROCHEMICAL STUDIES



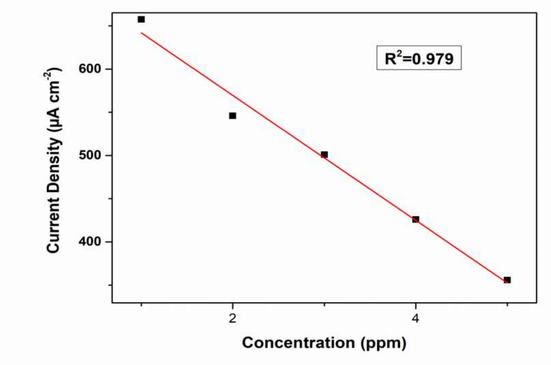
Modified electrode response with and without acetone



Modified electrode response at different scan rates



Modified electrode response at different concentration of acetone (100 mV/s)



Linear response of modified electrode with increasing acetone concentration

BENEFITS TO QATAR

Most hospitals in Qatar can use biosensors made of this material to detect diabetes in patients directly instead of blood tests which would help patients to get rid of the pain of drawing blood.

CONCLUSION

- XRD: CuO (Monoclinic), NiO (Cubic)
- Raman: 275 cm^{-1} (CuO), 519 cm^{-1} (NiO), 1072 cm^{-1} (NiO)
- SEM: $CuO - NiO$- spherical with rod like structure
- The modified electrode shows linear response for acetone concentration from 1-5 ppm
- Electrochemical: Sensitivity (72.32 µA .cm^{-2} .ppm^{-1}) - Biosensing (Acetone detection)

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