RESEARCH
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NiCo2O4 NANO MATERIALS FOR ELECTROCHEMICAL SENSING OF GALLIC ACID

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Abstract

Aim

The aim of this study was using NiCo2O4 nano,arterial for electrochemical sensing of Gallic acid

Introduction

3,4,5-trihydroxybenzoic acid commonly called as garlic acid is a polyphenolic compound which is commonly found in plants and plant parts. This chemical is known for various medicinal properties like ant inflammation, antioxidant and anti cancer activities which makes its an essential compound for analysis in various fields including medicine. In addition to its antioxidant effect it. Has also demonstrated neuroprotective properties in scientific studies…

Nanostructure material have demonstrated exceptional potential for enhancing performance as electrochemical sensing due to their property of high surface area, tunale morphology as well as high electron transferring properties. Among various nano parties NiCo2O4has gained considerable attention in recent times because of its potential application in electrochemical sensing. High electro sensing potential of this compound can be attributed to high surface area, promoting efficient mass and electron transfer which is a very advantageous feature for faster response.

Materials and method

For this research various chemicals were commercially obtained. The chemicals were then mixed in specific proportions to obtain NiCoO4. This compound was then coated on the electrode and then sent for various electrochemical tests. This electrode was then used for electrochemical sensing of Gallic acid

Results

Our compound NiCoO4 was successful in Gallic acid detection even at low concentration concluding that our material NiCo2O4 nanoparticles was successful in detection of Gallic acid and can be used in further research fir Gallic acid detection

Conclusion

By the end of the research we were able to conclude that our nano particles of NiCo2O4 were successful in detection of Gallic acid as well as its quantification and can be used in further research

Keywords

Gallic acid, NiCo2O4, electrochemical sensing, nanoparticles, cyclic stability

INTRODUCTION

Gall3,4,5-trihydroxybenzoic acid commonly called as garlic acid is a polyphenolic compound which is commonly found in plants and plant parts. This chemical is known for various medicinal properties like ant inflammation, antioxidant and anti cancer activities which makes its an essential compound for analysis in various fields including medicine. In addition to its antioxidant effect it. Has also demonstrated neuroprotective properties in scientific studies…

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(GA), a naturally occurring polyphenolic compound abundant in various fruits,

MATERIALS AND METHOD

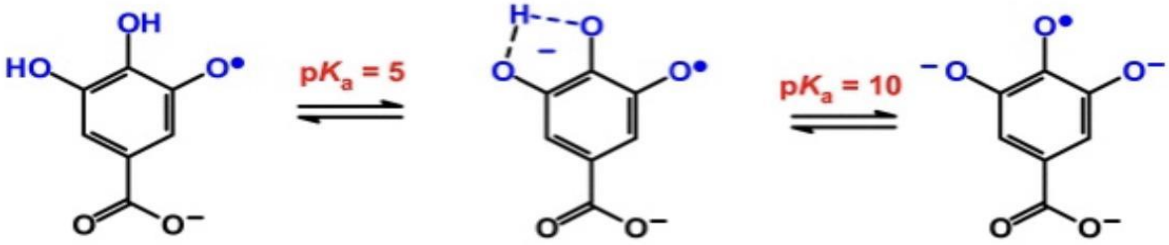
This current study was done in the department of Forensic odontology in Saveetha dental college and hospital, Chennai, Tamil Nadu, for a period of 4 months.

Chemicals and reagents

Chemicals and reagents were commercially obtained. All the chemicals were of pure and analytical grade and used without any further purification

Fabrication of particles

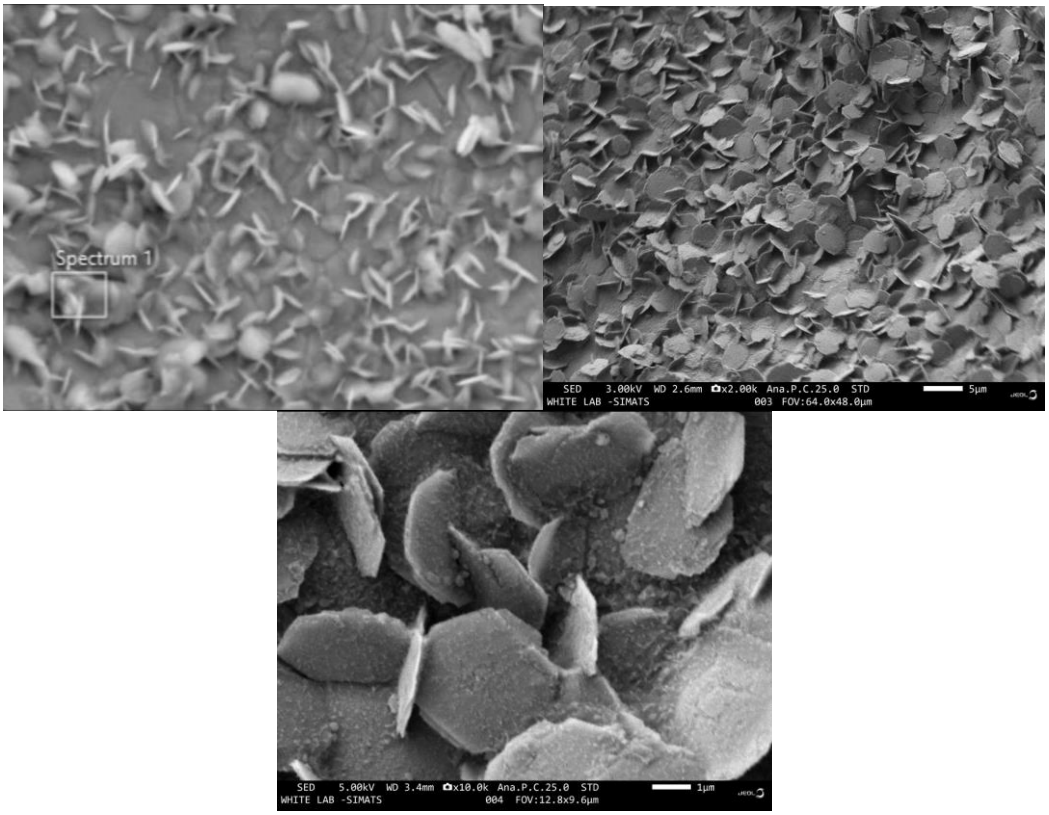
The following technique was used for fabrication of our particles. 0.293 grams of Nicole nitrate was mixed with 0.146g of cobalt nitrate along with 0.909g of urea. This mixture was stirred for 30 mins till a well mix was obtained. This solution was then sent to the hydrothermal chamber at 140C for 3 hours. The compound was then calculated at 400C and a drop test was conducted on the compound. The samples were then sent for electrochemical sensing of Gallic acid



RESULTS

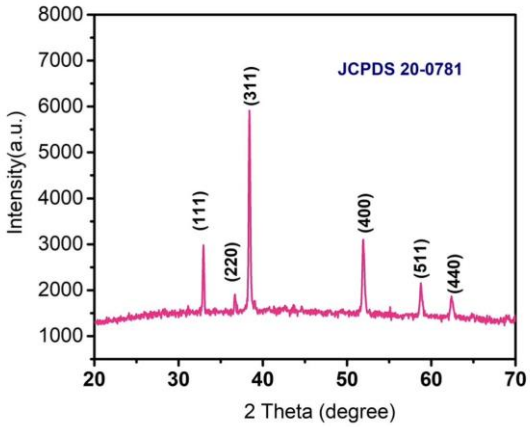
Study of SEM Analysis of NiCo2O4

An examination of the morphology of prepared NiCo2O4 was performed by SEM. It was revealed by the SEM image that the prepared materials contain our respective chemical compounds. The synthesized NiCo2O4 particles are depicted in Fig. 2.(a)(b)(c)

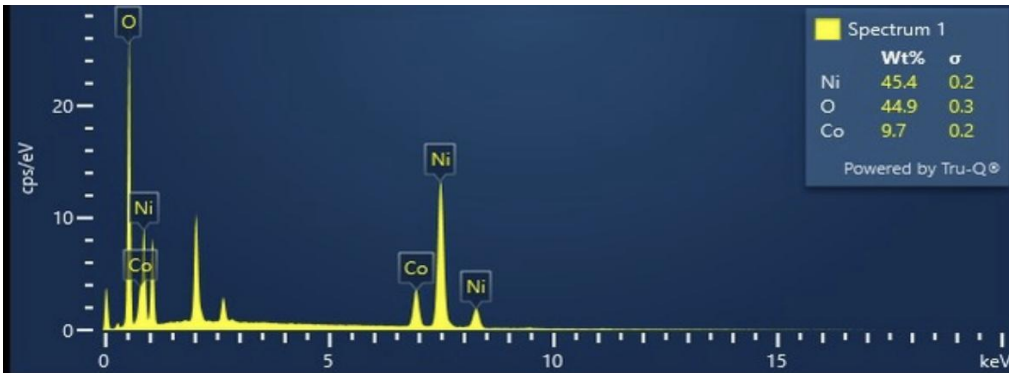


Study of X-ray Diffraction Characteristics of NiCo2O4

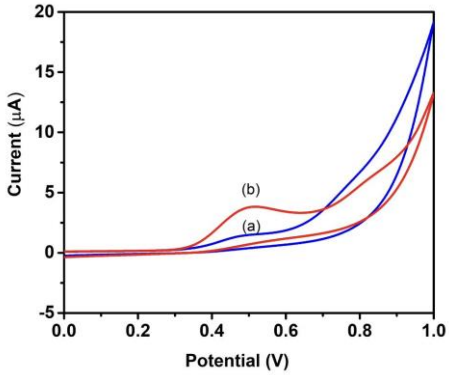
An X-ray diffraction pattern of synthesized NiCo2O4 is depicted in Fig. 1.(a). As confirmed by XRD patterns, the cubic phase of NiCo2O4 nps formed the standard JCPDS card No. 20-0781. The highest peak was for (311). The diffractogram showed no crystalline contamination, indicating that the NiCo2O4 material synthesized was impurity-free.



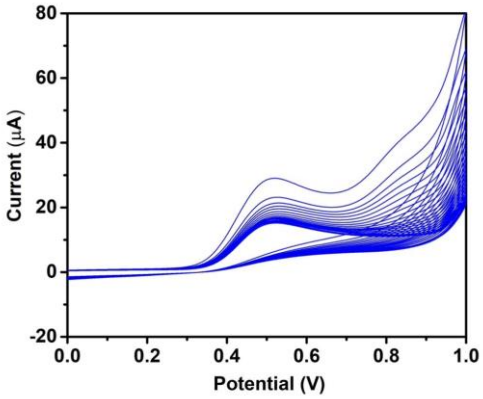
EDAX analysis of NiCo2O4
The EDAX analysis of synthesized NiCo2O4 nanoparticles is depicted in Fig.3.



NiCo2O4 bare modified analysis for Gallic acid
Using the cyclic voltammetry (CV) technique, the electrochemical behavior of the NiCo2,O4@GP electrode was investigated. The CV responses of the bare electrode and NiCo2O4 electrode were recorded.



cyclic stability analysis of Gallic acid
Fig 4 shows cyclic stability graph for Gallic acid



DISCUSSION

By the end of this research we were successfully able to detect Gallic acid using our chemical compound. After preparation of our compound the compound was sent for SEM analysis where a hexagonal pattern was obtained under the microscope. Following that a XRD was performed to confirm whether the particles obtained on preparation were NiCo2O4 or not. It was found that the chemical compound obtained was NiCo2O4 and was matched with a JCPDS card and confirmed.

Further to check the purity of the sample an. EDAX was done and it was found that our samples were 100% pure. After that a cyclic Voltammetry electrochemical behavior was analyzed for our chemical. In the graph it can be observed that after coating with NiCo2O4 the detection of Gallic acid was more sensitive concluding that our chemical compound improves Gallic acid detection.

Further a cyclic stability was conducted to check if NiCo2O4 stays on the electrode or not and after 20 cycles the NiCo2O4 coating was still intact with the electrode indicating it can be used multiple times

Study conducted by feminus et al used modified electrode for estimation of Gallic acid from 2 different brands of green tea samples by Volta metric method under optimized conditions and after extraction if the samples the presence of Gallic acid was checked and the Gallic acid obtained were found to be satisfactory[10]

Another study a new electrochemical sensor with a satisfactory limit of high detection sensitivity was made for quantification of GALLIC. The final results obtained from that study provided evidence and played a pivotal role in increasing sensitivity of delphinidin coating and background. Oltammetrjc response.preliminary tests also demonstrated the potential as a valid alternative of most common analytical techniques [11]

In a study by Suresh babu et al where they synthesized nanorods by hydrothermal method had a distinctive GA detection at lower concentrations up to 0.1 ppm limit. Furthermore an excellent perspective for fabrication of sensor was obtained with additional functions and applications [12]

Another study by tashkhaourian et a, used SiO_2 nanoparticle modified carbon paste electrode along with phosphate bigger solution fir detection of Gallic acid.the electrode had high performance with enhanced adsorptive capability which concluded low levels detection of Gallic acid

CONCLUSION

In conclusion, this study demonstrates the provision potential of No o2O4 nano material for electrochemical sensing of Gallic acid. Our sensor exhibits a high sensitivity towards the selective detection of Gallic acid. While this research presents a significant advancement further work needs to be done to improve and optimize the sensor's performance to its fullest potential , evaluate its costing and it's reproducibility in various engineering and medical field. Development of similar sensors can help in significant improvement of overall medical and engineering areas using Gallic acid contributing to improved scientific understanding

Conflict of interest:

All the authors declare that there was no conflict of interest in the present study

Author Contributions:

All the authors have equally contributed.

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Ethical clearance number : Since it is an in vitro study, ethical clearance is not needed.

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