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# $Co_3O_4$-NiO Nanocomposites for the Electrochemical Determination of L-Tyrosine

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**Summary:**

$Co_3O_4$-NiO nanocomposites at different molar ratios have been prepared using a simple sol–gel method. The composite were used as electrode materials for detecting L-tyrosine, modifying a screen printed electrode (SPCE). The electrochemical sensor response to L-Tyrosine (concentration-Tyr) in PBS pH=7.4 and at [0μM–100μM] has been investigated by using cyclic voltammetry (CV).Results obtained demonstrated that the composite $Co_3O_4$-NiO/SPCE sensors exhibit good electroanalytical performances, with a maximum of sensitivity exibited at a $Co_3O_4$:NiO ratio = 1.

**Keywords:** Cobalt Oxide-Nickel Oxide nanocomposite, Tyrosine, Electrochemical sensor.

## Introduction

Tyrosine (Tyr) is an aromatic amino acid critical to the synthesis of compounds such as neurotransmitters and melanin [1,2]. Abnormal Tyr concentrations in plasma/urine can also be used as a biomarker in the detection of various diseases like alkaptonuria, tyrosinemia, and liver disease [3]. Therefore, an easy quantification assay of Tyr is critical. To attend this purpose, researchers have developed numerous analytical methods. However, implementing such methods is expensive and complex, thus, the necessity of the development of a sensitive and low-cost platform for the determination of Tyr is mandatory.

In this study, $Co_3O_4$-NiO nanocomposites (NCs) are synthesized through the sol-gel method and employed to improve the detection of Tyr by means of electrochemical sensors, modified by NCs of different $Co_3O_4$-NiO ratios.

## Materials and Methods

### *a. Co3O4-NiO preparation*

The synthesis of $Co_3O_4$-NiO NC was carried out as follows: first, 1.19g of $Co_3O_4$ was dissolved in 10mL of hydrochloric acid (HCl) and continuously stirred at room temperature until the solution became transparent and uniform. Then, various quantities of pure nickel oxide at 0.186 and 0.37g were dissolved in 2M citric acid (HOC (CO2H) $(CH_2CO_2H)_2$) solution and stirred at room temperature till the solution became transparent and uniform.
Subsequently, the $Co_3O_4$ and NiO solutions were mixed and placed on a heating plate at a temperature of ~350°C. The materials were fully burned, and, in this way, two samples were obtained with different $Co_3O_4$-NiO molar ratios. At last, the powdered samples were annealed in a glass furnace for 2 hours at 400°C.

### *b. Electrode preparation.*

The modified SPCE electrodes are prepared by a simple drop-casting method with $Co_3O_4$-NiO NC. Herein, 1mg of $Co_3O_4$-NiO NC is dissolved in 1mL aqueous solution was assembled through the dispersion of 1 mg $Co_3O_4$-NiO NC and ultrasonication for 1 hour.

### *a. Electrochemical tests.*

The modified screen-printed carbon electrode (SPCE) were prepared by dispersing the NC electrode materials on the working carbon electrode of SPCE platform (Metrohm-DropSens). All electrochemical analyses were performed using a Metrohom Autolab galvanostatic potentiostat equipped with NOVA 2.1 data acquisition software.

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## Results and Discussion

XRD patterns are depicted in Figure 1. Reflection peaks of NiO and $Co_3O_4$ are observed in the diffraction patterns oft he composite samples, indicating they are through composites.

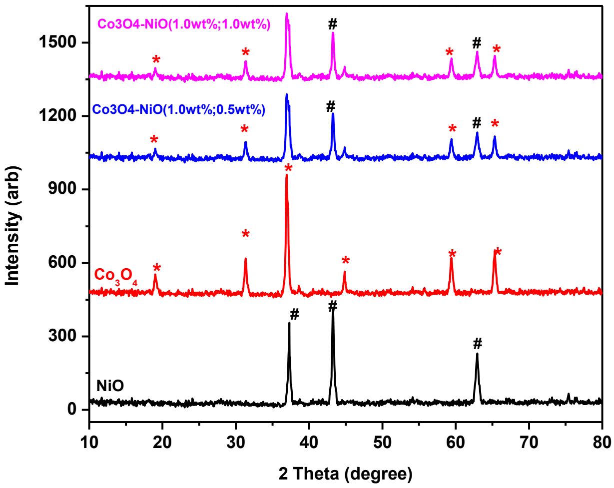
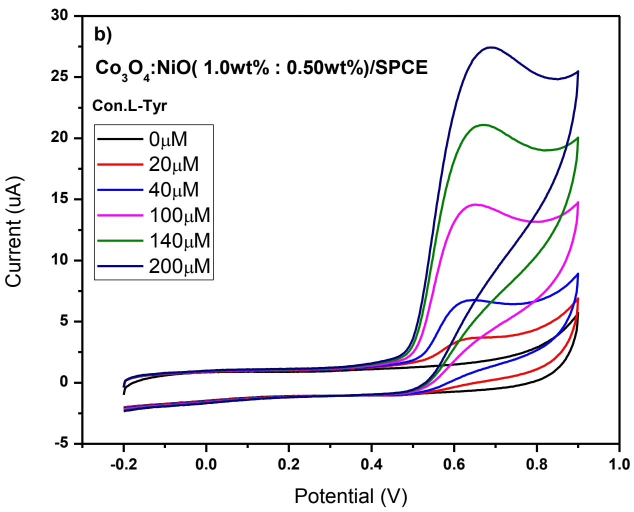



Fig.1. XRD spectra of pure NiO (black line), pure $Co_3O_4$ (red line), $Co_3O_4$-NiO(1.0wt%;0.5wt%) (blue line), and $Co_3O_4$-NiO(1.0wt%;1.0wt%) (pink line)

### a. *Electrochemical Tests*

The L-Tyr determination is performed by voltammetric technique at different concentrations (see Figure. 2a) to compare the sensitivity of the modified electrodes Calibration curves are plotted and presented in Figure.2b, showing that the composite $Co_3O_4$-NiO/SPCE sensors exhibit good electroanalytical performances, with a maximum of sensitivity exibited at a $Co_3O_4$:NiO ratio = 1.



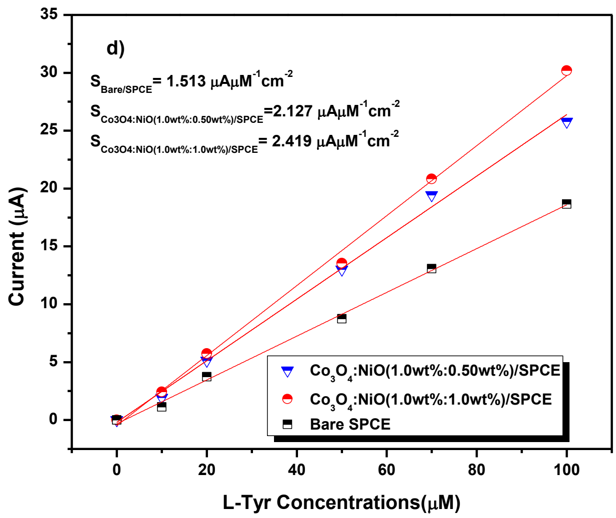




Figure.2. a) CV test in PBS solution containing L-Tyr (0μM-200μM) at 50mV/s scan rate on (a) $Co_3O_4$LNiO (1.0wt%:0.5wt%) and d) the calibration curve.

## *Conclusion*

$Co_3O_4$-NiO NCs have been synthesized successfully via the sol–gel method .XRD, SEM and EDX measurements indicate a NC structure and the presence of crystalline metal oxide nanoparticles. More studies are to be done in order to optimize the synthetic approach to improve the quality of $Co_3O_4$-NiO doped films, which to the best of our knowledge may represent a new electrode material for electrochemical sensing applications.

## References

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