Project Reference Number: 46S_BE_1945

Title of the project: Nanotechnology based electrochemical sensor for determination of antibiotics

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Introduction :

Nanotechnology has revolutionized the field of electrochemical sensor for the determination of antibiotics. These sensor offer enhanced sensitivity, selectivity, and portability compared to traditional methods. The misuse of antibiotics has led to the emergence of antibiotic resistant bacteria, emphasizing the need for efficient monitoring techniques. By incorporating nanomaterials such as carbon nanotubes, graphene, metal nanoparticles, and molecularly imprinted polymers, these sensors can achieve improved performance.

Nanotechnology-based electrochemical sensors operate on the principle of selective recognition and signal transduction, enabling accurate detection of antibiotics in various samples. Presently we use analyte as levofloxacin from the family of fluroquinolone antibiotic , because it is available in the pure form.

Background:

The development of nanotechnology based electrochemical sensors for the determination of antibiotics has gained considerable attention in recent years. Antibiotic resistance has become a global health concern, emphasizing the need for reliable methods to monitor antibiotic levels. Traditional approaches to antibiotic analysis have limitations in terms of cost, complexity, and time. Nanotechnology offers unique opportunities to enhance the performance of electrochemical sensors by utilizing nanomaterials properties, such as high surface area, conductivity, and catalytic activity. These nanotechnology-based sensors enable rapid, sensitive detection of antibiotics.

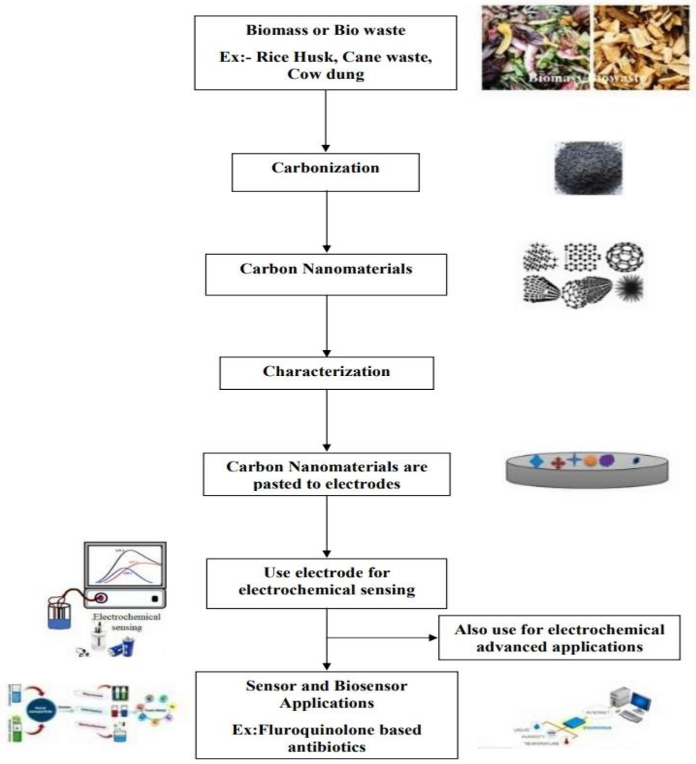
Objectives:

- Preparation of ecofriendly carbon based nanoparticles from sugarcane bagasse.
- Characterization of nanoparticles by SEM ,EDS and XRD Methods.
- Preparation of electrodes based on carbon nanomaterials.
- Analysis(sensing) of antibiotic molecules using nanomodified electrodes by electrochemical method.

Methodology :

- Carbonization (sugarcane bagasse to carbon particles).
- Characterization of activated nano particles (SEM, EDS, XRD).
- Preparation of electrode with activated carbon particles.
- Detection of antibiotics(levofloxacin) using Electro Analyzer, CHI Company, model D630. The voltametric measurement were carried out in a 10 ml single compartment, three electrode glass cell.

Flow chart for the proposed project :



Results:

Sugarcane bagasse was considered for the preparation of carbon nano materials. first, sugarcane bagasse was carbonized to get carbon materials, then dry activation method is used to activate the carbon materials. And their characterization test is done for confirmation of active carbon nano materials.

A 7gm of graphite and a 3ml of paraffin oil (mineral oil) were used to prepare bare electrode and a 7gm of graphite and a 3ml of paraffin oil along with 0.05gm of activated carbon nano material are used to prepare activated carbon pasted electrode. Characteristics comparison of bare electrode and the modifier (activated carbon) pasted electrode is done at same concentration (9.9 ml of buffer solution and 0.1 ml of analyte) and results are shown in Fig1.

And also tested the pH characteristics of modifier pasted electrode with different buffer solutions and results are shown in Fig2 . From the test results, it is been observed that for pH 4, cyclic voltammetry graph shows the high peak. Hence pH4 solution was tested with different concentration of analyte(levofloxacin) and results are shown in Fig3.

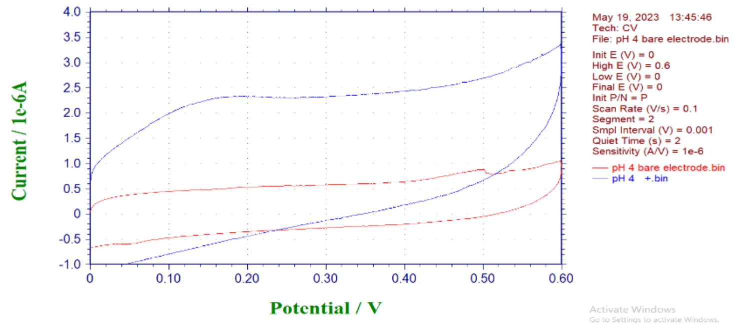


Fig1. Comparison of bare and modifier electrode

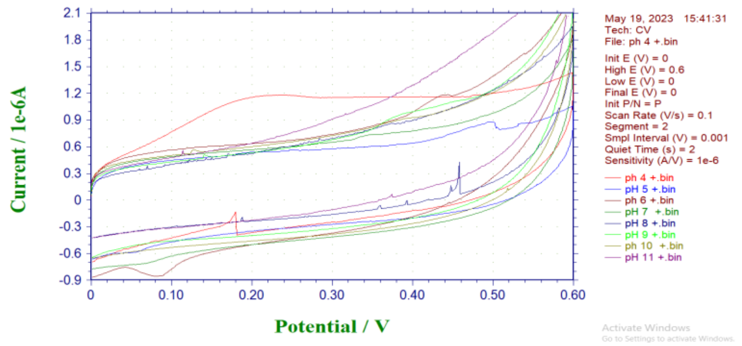


Fig 2. Modifier electrode with different pH buffer solution

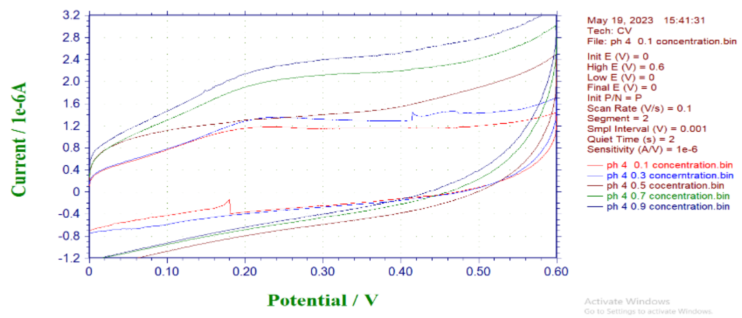


Fig3. Modifier electrode with different concentration of analyte in pH 4 solution.

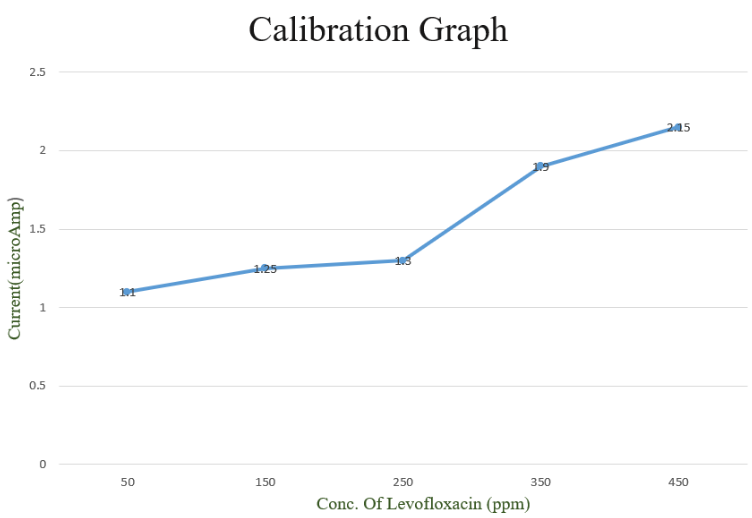


Fig4. Graph against concentration of levofloxacin(ppm) and current (microAmps)

Scope for Future work:

The future scope of nanotechnology-based activated carbon paste electrode (ACPE) sensors for the determination of antibiotics lies in several areas. This includes optimizing sensor performance by incorporating advanced nanomaterials, exploring innovative recognition elements for improved selectivity, and enhancing miniaturization and portability for on-site analysis. Additionally, there is a need to investigate multianalyte detection capabilities, evaluate sensor performance in complex matrices, address biosafety concerns and regulatory considerations, and integrate artificial intelligence for enhanced data analysis. By addressing these aspects, future research can advance the field and enable the practical implementation of ACPE sensors in antibiotic determination, benefiting various sectors such as healthcare, food safety, and environmental monitoring.