INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	**Ph.D.**

Thesis Title: **Advanced Electrochemical Platforms for Selective and Simultaneous Detection of Emerging Pollutants**

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Thesis Submitted to the Academic Division	:	**Department of Chemical Engineering**
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Key words for description of Thesis Work	:	**Bioinspired Ag nanostructures; 1D ZnO nanorods; Biobased 2D ZnO nanostructures; Carbon quantum dots; 1D Bi_2S_3 nanorods; Bi_2S_3-ZnO nanocomposites; Simultaneous sensing; Emerging pollutant sensing**

SHORT ABSTRACT

This work investigates on the development of electrochemical sensing platforms and their applications in detecting target analytes. In the first part, phyto-analytic formation of Ag nanostructures was carried out using the bio-extract of *Citrus limetta* for ciprofloxacin detection. The developed sensor showed the limit of detection (LOD) of 0.199 µM. A 12.38% reduction in the peak current was noted up to the 10th reused cycle. Rapid delamination of surface-embedded catalysts remained a limitation.

Chemical-based synthesis of 1D ZnO vertically aligned nanostructures (VANs) on FTO was further taken up for electrochemical aniline sensing to overcome catalyst delamination. ZnO-VANRs/FTO showed LOD of 0.193 µM. The peak current was decreased by 2.63 % up to the 6th cycle. Although the chemical synthesized VANs have proven effective for sensing, achieving bio-based growth of VANs on FTO remains a fundamentally challenging task.

A new bio-based route was successfully developed for synthesising 2D ZnO VANs onto the FTO using *Sechium edule* fruit extract for p-Chloroaniline sensing. ZnO-VANs(bio)/FTO@pH7 exhibited LOD of 0.021 µM. Moreover, bioinspired VANs functionalized with carbon quantum dots (CQDs) derived from the biomass could significantly enhance the sensor's performance.

Further, 2D ZnO VANs was synthesized in a bioinspired route and functionalized with CQDs. The developed sensor exhibited LOD of 0.0066 µM. The influence of morphological attributes (2D to 1D) of bio-based VANs were also explored for electrochemical sensing applications.

This doctoral study also investigates on the development of nature-inspired 1D Bi_2S_3 VANs on FTO using *Sechium edule* extract for mancozeb sensing. The developed sensor exhibited LOD of 0.0085 µM. It could effectively detect mancozeb spiked in the environmental matrices, which was comparable to HPLC. However, environmental matrices often contain multiple emerging pollutants, making simultaneous detection crucial.

Finally, the bio-based synthesis of Bi_2S_3-ZnO nanocomposites was carried out using *Sechium edule* extract for dual-analyte selective and simultaneous monitoring of phenylbutazone and sulfamethoxazole. For simultaneous sensing, the Bi_2S_3-ZnO(bio)/GCE achieved LODs of 0.222 and 0.089 µM for phenylbutazone and sulfamethoxazole, respectively.