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ELECTROCHEMICAL SENSING OF NICOTINE USING LASER-INDUCED GRAPHENE SCREEN PRINTED ELECTRODE

(2025) *IIUM Engineering Journal*, 26 (1), pp. 293-307.

DOI: 10.31436/IIUMEJ.V26I1.3392

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Abstract
Nicotine is one of the major addictive substances in tobacco plants, which caused a global pandemic. Rapid detection of nicotine is crucial to allow quick identification of harmful substances that will cause significant health risks, especially with the recent rise in electronic cigarettes. Since smoking cessation programs are typically limited to screening, awareness, consultation, medication, and follow-up activities, there is a need for a device to check the nicotine level in former smokers at the end of the programs. However, most of the current nicotine detection is based on chromatography technology, which involves complicated sample pre-treatment and bulky and expensive instruments. Thus, screen-printing technology employing electrochemical detection is a promising solution as it offers a simple and portable setup for nicotine detection. Yet, conventional screen-printed electrodes (SPE) have relatively low sensitivity and need modification to improve the electrode material. Therefore, this work aims to investigate the performance of laser-induced graphene (LIG) as SPE-modified electrodes to detect the presence of nicotine through electrochemical measurements. A finite element simulation was conducted to investigate laser power's effect on the induced graphene's quality. The CO2 laser with 3W laser power, Dots per inch (DPI) of 1200, and a laser speed of 13% was used to fabricate the LIG sensor on a Kapton substrate. Material characterizations such as SEM, EDX, and Raman spectra were performed on the fabricated LIG-SPE to confirm the presence of LIG. Cyclic voltammetry (CV) measurement was done using 0.1M [Fe (CN)6]3-/4- and 0.1M KCL to find the suitable scan rates. At a fixed scan rate of 50 mV/s, the sensor's performance was analyzed using 0.1M of nicotine with 3 different phosphate buffer solutions (PBS) of pH 5, pH 7, and pH 9 at different nicotine concentrations. Nicotine with PBS pH 5 solution was found to be the optimum measured solution, with the value obtained for R^2 having the highest value of 0.9988 and the lowest LOD of 4.2183 μM. The proposed electrochemical sensing of nicotine using a laser-induced graphene screen printed electrode can detect nicotine with high linearity at different pH levels of PBS buffer solution.

Author Keywords
electrochemical; laser-induced graphene; nicotine; screen-printed electrode; shrimp virus

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Publisher: International Islamic University Malaysia-IIUM

ISSN: 1511788X
Language of Original Document: English
Abbreviated Source Title: IIUM Eng. J.
2-s2.0-85216432689
Document Type: Article

Publication Stage: Final
Source: Scopus