# Simple Low-Cost Fabrication of Laser-Induced Graphene-Based Electrochemical Sensors

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Graphene-based materials are of interest in electrochemical sensing due to their unique properties, such as high surface areas, high conductivity, and electrocatalytic behavior [1]. In this scenario, Laser-Induced Graphene (LIG) has emerged as an exciting material. LIG can be patterned on flexible substrates in ambient conditions using a fast and facile laser irradiation process. Based on that, we are addressing a simple low-cost fabrication of an electrochemical sensor based on laser-induced graphene for the detection of nicotinamide adenine dinucleotide (NADH) at low potential (50 mV vs Ag/AgCl). By using mild laser power conditions (1.5 W laser power at 405 nm), it was possible to obtain electrically conductive graphene (with a sheet resistance of 24.38± 2.19 Ω/□), on polyimide substrate, displaying a porous 3D morphology rich in defects, as shown in the scanning electron microscopy image (SEM) and Raman spectrum (with high 2D band intensity at 1350 $cm^{-1}$) respectively in Figure 1. A massive number of electrochemical sensors based on LIG was easily fabricated as shown in Figure 2. The pseudo reference electrodes based on Ag/AgCl were obtained by a simple chlorination approach on a deposited silver layer, using a commercial bleach solution, resulting in a stable potential, showing a potential difference of less than 2.5 mV vs Ag/AgCl (3 mol $L^{-1}$ KCl) commercial electrode. The electrochemical sensors based on LIG were employed to detect NADH, an important essential coenzyme for neurotransmitter activities, with a linear range of 0.05-10 mmol $L^{-1}$. The presence of residual oxygenated functional groups (C-O/C=O) on LIG structure is essential for the electrocatalytic activity towards the electrooxidation of NADH at low potential [2].

## References

[1] Zhao, L. *et al. ACS Appl. Mater. Interfaces* (2023) doi:10.1021/acsami.2c20859.
[2] de Camargo, M. N. L. *et al. Electrochim. Acta* **197**, (2016) 194–199.

## Figures

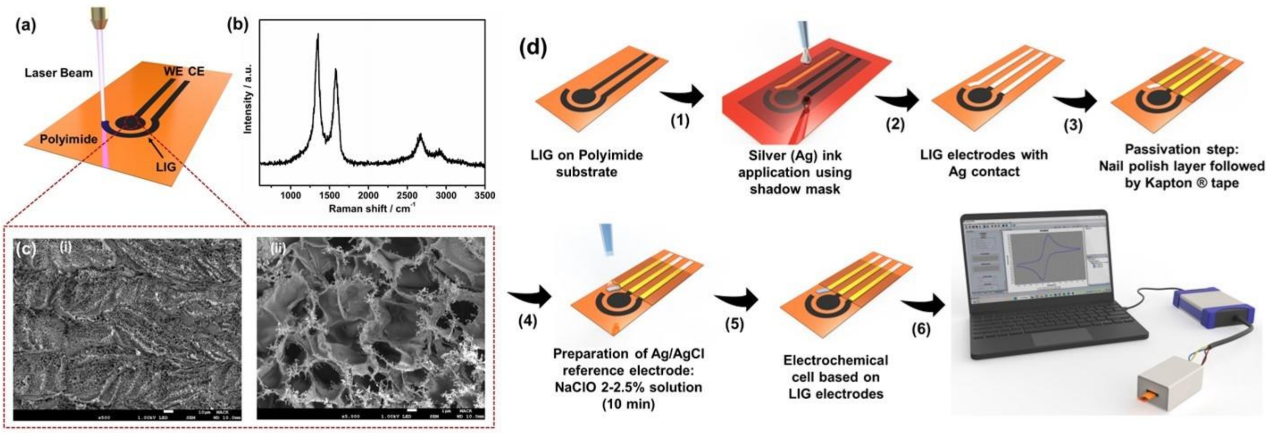


**Figure 1:** Schematic representation of the preparation of LIG on polyimide substrate (a). Raman spectrum of LIG (b) and SEM images low (i) and high (ii) magnification of LIG surface showing the porous structure (c). Representation of each experimental step of fabrication of LIG-based electrochemical sensors.

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