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Ultrasensitive 3D Carbon Microelectrodes for Electrochemical Biosensing Application

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This work represents the fabrication and electrochemical characterization of 2D and multi-layered three-dimensional (3D) pyrolytic carbon microelectrodes and their further application in electrochemical biosensing.

Carbon materials have several attractive properties such as wide electrochemical potential window, biocompatibility and ease of functionalization, makes it an ideal material for microelectrodes used as biosensor, scaffolds or energy storage devices [1, 2]. However, device sensitivity and biological signals from 2D electrodes are limited due to the low surface area from 2D nature of the electrode. Towards this a 3D carbon microelectrode is fabricated and transferred on the working electrode of an electrochemical cell using UV photolithography technique followed by pyrolysis [3]. The feature size as small as 5µm is fabricated which is comparable to cell dimensions. The 3D electrodes had higher sensitivity (2 folds higher) then 2D electrodes in standard 10mM ferri/ferrocyanide redox probe. For a proof of concept study, we have tried to combine this electrode with some based material and further used for electrochemical biosensing application. Electrochemical biosensing response showed that these kinds of electrodes can be used for the development of ultrasensitive low cost biosensors.

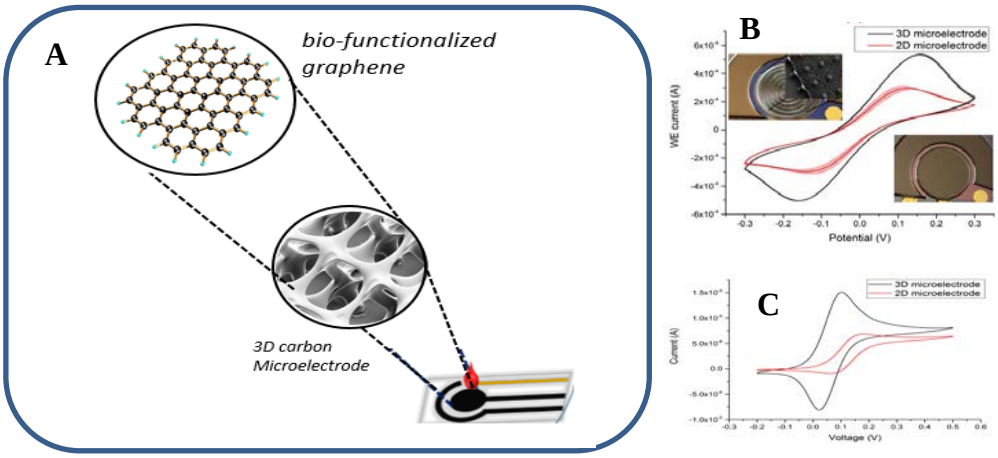

Figure 1: A. Schematic diagram of 3D carbon electrochemical bio-sensing device. B and C shows the higher sensitivity of 3D microelectrode in 10mM ferri/ferrocyanide and 1mM Glucose respectively.

References

[1] McCreery RL. Chem Rev.108(7):2646–87 (2008).
[2] Amato L, et al. Adv Funct Mater. 24(44):7042–52 (2014).
[3] Lim Y, Heo J-I, Shin H. Sensors Actuators B Chem.192(2014):796–803