Carbon materials-based sensors: State-of-the-art and future prospects

M. Syamsul[ab*], M. Shaili[b], E. Suaebah[b], H. Kawarada[c,d]

[a]*Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia, 11800 USM, Penang, Malaysia.*

[b]*Faculty of Science and Engineering, Waseda University, Tokyo 169-8555, Japan.*

[c]*National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Ibaraki 305-8565, Japan.*

[d]*The Kagami Memorial Laboratory for Materials Science and Technology, Waseda University, 2-8-26 Nishiwaseda, Shinjuku, Tokyo 169-0051, Japan*

[*]*Corresponding author: nasyriq@usm.my*

Abstract

In this work, the focuses were made on carbon related materials such as diamond and graphene as solution-gate field-effect transistor (SGFET) towards pH sensing of carboxyl and amine functional groups and its compatibility with estrogen (17β-estradiol) aptamer. The functionalization of diamond graphene with carboxyl were achieved through anodization by applying a sequential potential scan in Carmody buffer solution (pH 7). The carboxyl-terminated surfaces were exposed to nitrogen radicals to generate an amine-terminated surface [1]. Raman spectroscopy was used to determine the defect density of the carbon related materials caused by the anodization. The sequential anodization in Carmody buffer solution at pH 7 had low defective effect on carbon structure and shows that the original structure of carbon was conserved [2]. The pH sensitivity will be presented in detail and will be finalized with the compatibility with estrogen (17β-estradiol) aptamer, which the supporting DNA strands were immobilized and an aptamer was hybridized to prepare a detection pair to bind with any 17β-estradiol molecule, as the aptamer captures the 17β-estradiol molecule naturally [3]. These detections will be demonstrated through optical (fluorescence microscopy) and electrical measurements (current-voltage) and summarized with carbon materials-based sensors towards the actual application of designing diamond/graphene-based biosensors.