Selective lectin multimodal biosensing on functionalized graphene

Tereza Koukalová[1]
Petr Kovaříček[1], Pavla Bojarová[2]

1) *J. Heyrovský Institute of Physical Chemistry of the CAS, Dolejškova 2155/3, 182 23, Prague 8, Czech Republic*
2) *Institute of Microbiology of the CAS, Vídeňská 1083, 142 20 Prague 4, Czech Republic*

tereza.koukalova@jh-inst.cas.cz

Abstract

Graphene has a wide potential for applications in biotechnology such as selective biosensor due to its electronic properties and strict monolayer character. However, the outstanding sensitivity is compensated by null inherent selectivity, which must be introduced by secondary processing, such as chemical functionalization. Using a reaction sequence, we were able to covalently graft carbohydrates moieties onto graphene. Reaction with gaseous XeF2 introduces C-F defects in the structure, which are smoothly exchanged for strong nucleophiles, such as propargylamine. The triple bond can be then used in CuAAC reaction with azide-terminated N-acetylglucosamine (GlcNAc) oligomers to tether these carbohydrates onto the monolayer. GlcNAc oligomers bind lectins specifically and reversibly. We investigate the affinity of on-surface grafted glucosamines of different length towards lectins (WGA, Triticum vulgaris). In the experiments we use mono- to penta-GlcNAc and evaluate the strength of binding by competitive series. The GlcNAc-grafted graphene can be used as a selective active layer of lectin sensors using spectroscopic, microscopic, electrical or mass detection.

References

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Figures

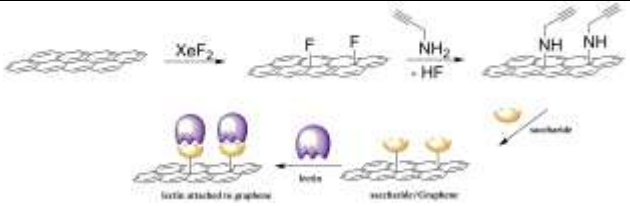

Figure 1: Functionalization of graphene, covalent grafting of carbohydrates and selective binding of WGA.

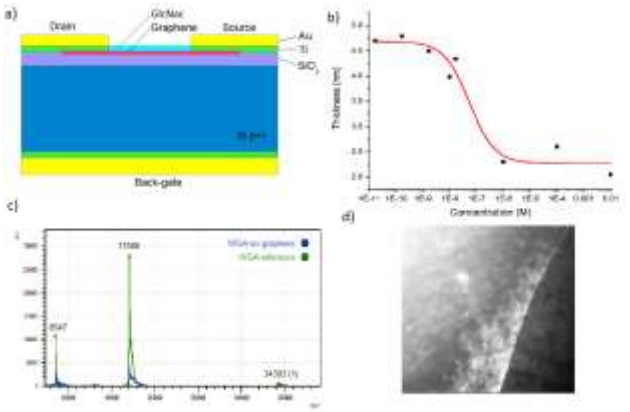

Figure 2: Modes of detection using the GlcNAc functionalized graphene: a) GFET configuration for electrical detection, b) microscopic detection by AFM, c) mass spectrometry, d) fluorescent measurement/imaging.