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Conjugates of biomolecules and carbon nanomaterials like graphene and carbon nanotubes can find a wide range of applications in electronics, photovoltaics, biosensors, regenerative medicine, etc. Most bioconjugates are actively studied in the application of point-of-care biosensors due to low cost, high sensitivity, selectivity, and usability. Due to chemical inertness of graphene surface and demand for preserve its surface intact immobilization of biomolecules is performed using hydrophobic reaction in most applications. Azide-based photochemistry is a novel tool for covalent immobilization of different biomolecules on carbon surface without disturbing its electronic structure [1]. Moreover, the proper conjugation itself can be the way of tuning properties of biocunjugates (Figure 1).

Field -effect transistors based on individual single-walled carbon nanotubes (SWCNT) photochemically modified with green fluorescent proteins (GFP) demonstrate wavelength selective response to light irradiation. Using genetically engineered proteins novel optoelectronic devices based on GFP and carbon nanotubes have been demonstrated [2]. Changing the attachment side of protein to SWCNT results in different mechanisms of charge transfer turning SWCNT/GFP conjugates to active optoelectronic devices like optoelectronic memory devices.

Graphene based field-effect transistors (GFETs) in conjugation with bioreceptors is considered as cost-effective, high-sensitive, easy in use devices for point-of-care biodiagnostics. Recently, GFET-based biosensors with immobilized aptamers were found as reliable tools for direct detection of small molecules (with mass less 1 kDa). In the assay the aptamer is considered as a larger molecular and detection mechanism is based on conformational changes in the structure of aptamer when it binds to small molecules [3]. Aptamer immobilization process becomes an important issue of the sensor performants. Photochemical binding of aptamer to graphene surface methods was developed to improve the stability and sensitivity of the graphene-based aptasensors in heart failure biomarker detection [4].

References

[1] Zaki, A. et al., RSC Advances 8 (2018) 5768-5775.
[2] Gwyther R.E. et al., Advanced Functional Materials *32* (2022) 2112374.
[3] Nekrasov N. et al., Biosensors and Bioelectronics *200 (2022)* 113890.
[4] Nekrasov N et al., *Biosensors 12* (2022) 1071.

Figures

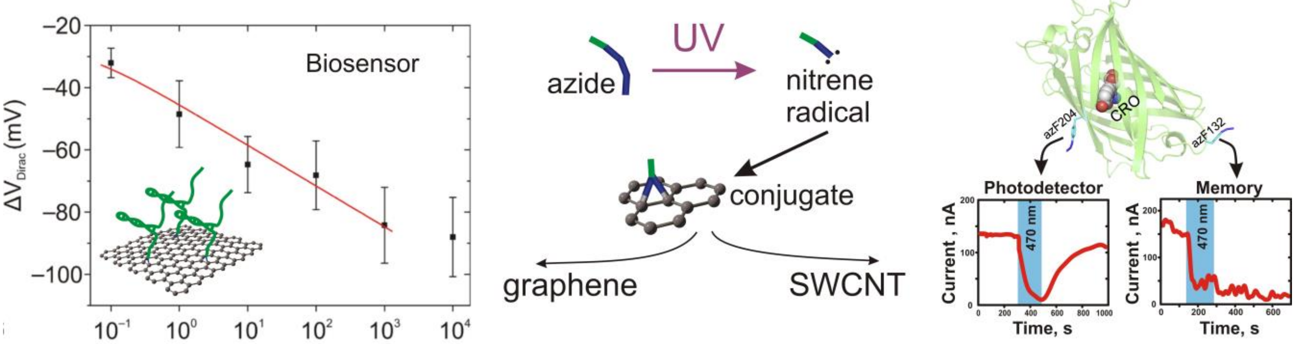

Figure 1: Photochemical immobilisation of aptamer (*left*) and protein (*right*) in development of graphene based aptasensors and SWCNT-based optoelectronic devices, respectively.