Highly sensitive graphene biosensor by monomolecular self-assembly of receptors on graphene surface

Ji Eun Kim
Woo Jong Yu

Department of Electronic and Electrical Engineering, Sungkyunkwan University, Suwon, 16419, Republic of Korea

libettyil@naver.com, *micco21@skku.edu*

Graphene has attracted a great deal of interest for applications in bio-sensing devices because of its ultra-thin structure, which enables strong electrostatic coupling with target molecules and its excellent electrical mobility promising for ultra-fast sensing speeds. However, thickly stacked receptors on the graphene's surface interrupts electrostatic coupling between graphene and charged biomolecules, which can reduce the sensitivity of graphene biosensors. Here, we report a highly sensitive graphene biosensor by monomolecular self–assembly of newly designed peptide protein receptors. The graphene channel was non-covalently functionalized using peptide protein via the π-π interaction along graphene's Bravais lattice, allowing ultra-thin monomolecular self-assembly through graphene lattice. In thickness, dependent characterization, a graphene sensor with a monomolecular receptor (thickness less than 1 nm) showed five times higher sensitivity and three times higher voltage shifts than graphene sensors with thick receptor stacks (thicknesses greater than 20 nm), which is attributed to xcellent gate coupling between graphene and streptavidin via an ultrathin receptor insulator. In addition to having a fast-inherent response time (less than 0.6 s) based on extremely high carrier mobility in graphene, our graphene biosensor is a x`promising new platform for highly sensitive real-time monitoring of biomolecules with high spatiotemporal resolution.

References

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Figures

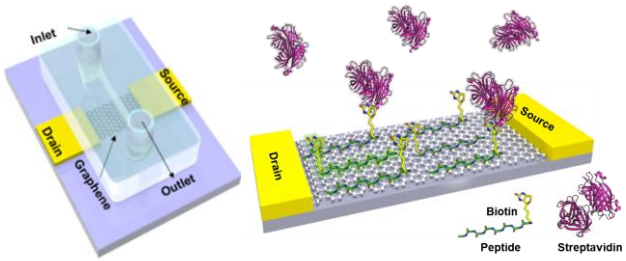

Figure 1: Schematic image of graphene-FET biosensor integrated with PDMS microfluidic cell (Right) and graphene biosensor capturing streptavidin (Left).

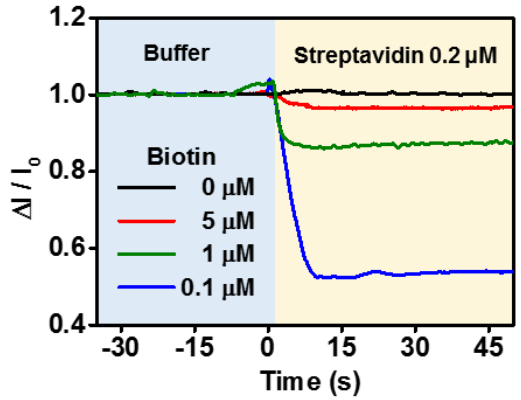

Figure 2: Real-time electrical measurement of graphene-biotin device before and after introducing the streptavidin precursor solution via flow through PDMS channel. Different concentrations of 0-μM (black line), 0.1-μM (red line), 1-μM (blue line), and 5-μM (green line) peptide-biotin stock solutions were used for self-assembly.