Graphene Based Materials for Biosensing Applications

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Abstract

Graphene (G) and graphene oxide (GO) are 2D materials known to possess superior functionalities. This arises from their versatility to tune their electronic, electrochemical, optical, mechanical and thermal properties. However, G and GO can also be easily functionalized with various biomolecules and this has led to numerous graphene-related biomedical sensing applications. Here we will demonstrate how G and GO can enable us to design and create substrates that can be used for both disease detection as well as wearable sensors for biomedical applications.

The electronic properties of graphene are strongly influenced by electrostatic forces and by changes in the local dielectric environment. These make graphene sensitive to the surface charge density of cells interfacing with it. We developed a graphene transistor array integrated with microfluidic flow device for detection of malaria-infected red blood cells at the single-cell level. Malaria-infected red blood cells induce changes in the conductivity of graphene and together with their characteristic conductance dwell times, detection of their disease state can be obtained.

A novel GO nanosuspension liquid-based microfluidic tactile sensor was developed. It consists of a UV ozone-bonded Ecoflex–polydimethylsiloxane microfluidic assembly filled with GO nanosuspension, which acts as the sensing element of the tactile sensor. This sensor is highly flexible and able to distinguish various user-applied mechanical forces it is subjected to, including pressing, stretching, and bending. This tactile sensor is also highly deformable and wearable, and capable of recognizing and differentiating distinct hand muscle-induced motions, such as finger flexing and fist clenching.

This work highlights the potential application of the GO nanosuspension liquid-based flexible microfluidic tactile sensing platform as a wearable device for real-time health monitoring.

References

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