Crowd surfing of graphene on a lipid monolayer

In the recent years a growing interest in graphene applications lead to the development of new biosensor devices. Graphene is a powerful sensor due to its extraordinary electron mobility, unique mechanical strength and optical properties. Consequently, the large surface area of graphene and its sensitivity enables the adsorption of different biomolecules and the detection of for instance, different gases, the sensing of several organic molecules, or for biomolecular detection. Therefore, lipid molecules are excellent candidates for modulating biomolecular interactions with graphene and reveal potential insights on biosensing applications. Coating graphene with lipid layers has the advantage of tailoring its surface chemistry, and reducing non-specific interaction of biomolecules. Also, lipid bilayers, which are primary constituent of cell membranes, can be functionalized with different molecules through lipid interactions, making a potential interface for biological systems. Therefore, it is essential to understand the stability and molecular structure of lipids interacting with graphene.

Based on Langmuir-Blodgett lipidic films to study graphene, and vice-versa, graphene is placed on top of a lipid monolayer. Surprisingly, the lipids remain intact in the presence of graphene and particularly rearrange in a more ordered, organized and compact layer underneath. Consequently, replacing the hard supports for a soft and molecular material, such as lipids, offers graphene a broader vision towards embedding graphene into a lipid bilayer and deliver inside of the body, a new concept of sensing device. Lipids can also be considered as an alternative to the conventional hard inorganic substrates, including other two-dimensional materials and Van der Waals heterostructures, where a structurally well-defined and electronically benign interface is of vital importance. Additionally, the lipids also ameliorated the electric performances of graphene, promising to measure the electrical signals emitted by graphene, for instance, in the body.
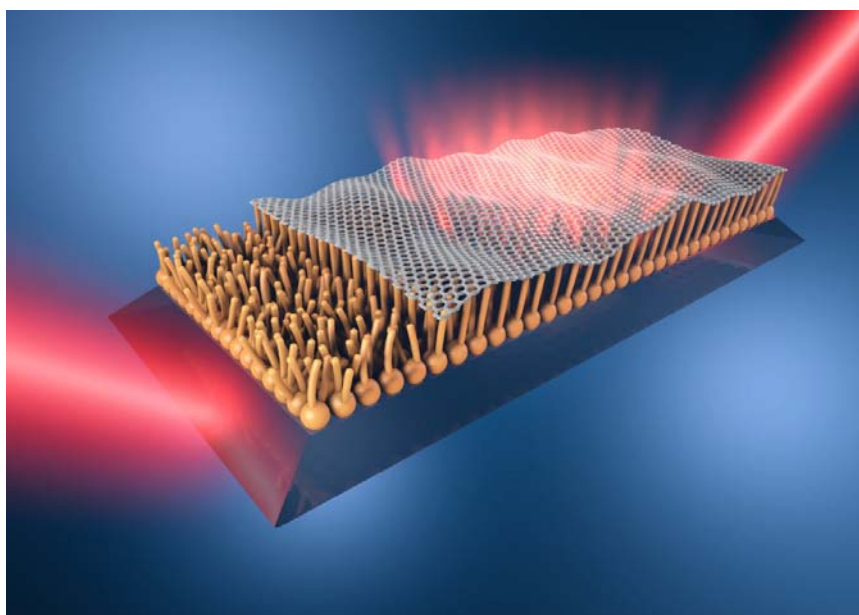

Fig. 1.

In conclusion, understanding the interactions between lipids and graphene provides a great potential for designing a well define interface for biosensing applications, where the electrical properties of graphene will be used to monitor biomolecular interactions. Moreover, these lipid coatings can also offer the possibility of chemically modulate the electrical properties of graphene by changing the chemical structure of the lipids as well as to investigate if graphene is sensible enough to detect small changes on its basal plane.

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