Interactions of Graphene and Other 2D Materials with Biological Molecules: A Focus on Viral Infections

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2D materials, including graphene, display unique physicochemical properties and have generated a high interest for biological applications. They have been exploited for photothermal therapy, in drug delivery, tissue engineering, and biosensing. Functionalization enables to impart novel properties and also to modulate their interactions with biological molecules. In this talk, I will show the impact of the functionalization of graphene family nanomaterials on their interactions with nucleic acids for gene therapy,[1] with immune cells allowing to increase their biocompatibility,[2] and with enzymes to enhance their biodegradability.[3] I will also give an overview of the literature on the interactions of 2D materials, mainly graphene family nanomaterials, with viruses, focusing on the main factors governing these interactions.[4] An emphasize will be given on how functionalization can endow the materials with selectivity. Different strategies for the development of 2D-material biosensors for the detection of viral infections will be presented, including the sensing of viruses, viral nucleic acids, and antibodies (Figure 1). I will critically detail the advantages and drawbacks of 2D materials, and provide insights for the development of future biosensors for virus detection. Some suggestions will be given to stimulate research that could help in designing advanced systems for preventing virus-related pandemics.

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FIGURE

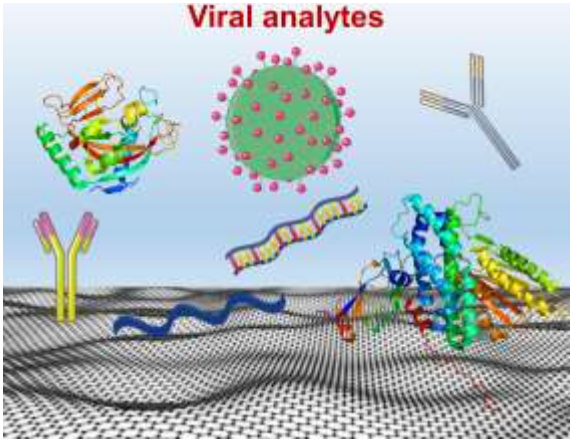

Figure 1: Biosensors incorporating two-dimensional materials.