Peculiarities of RNA Adsorption on Graphene/Graphene oxide

V.A. Karachevtsev
B.Verkin Institute for Low Temperature Physics and Engineering of NAS of Ukraine,
47 Nauky Ave., Kharkiv, 61103, Ukraine
e-mail: karachevtsev@ilt.kharkov

Hybrids formed by RNA and graphene family nanomaterials are considered as potentially useful multifunctional agents in biosensing and nanomedicine. In this contribution, the adsorption of double-stranded RNA on graphene (Gr) and graphene oxide (GO) in the aqueous suspension is reviewed. The main attention is paid to the observation of the features of the transformation of the structure of a relatively long RNA at adsorption on GO, the effect of the length of the RNA oligonucleotide on its adsorption on Gr and the inducing of a self-ordered RNA structure by GO are also discussed. The adsorption process of RNA on GO is considered by employing different experimental methods including UV-absorption spectroscopy adopted with the melting curve method, Atom Force Microscopy. For a detailed analysis of the interaction between RNA and Gr, a molecular dynamics (MD) simulation is involved in the consideration too.

As an example of RNA double-stranded (ds) poly(rA)·poly(rU) is taken for analyzing duplex adsorption on GO in the aqueous suspension [1]. The model of the adsorption of this relatively long ds-RNA onto GO is considered. It was concluded that poly(rA)·poly(rU) is mainly adsorbed to sp^2-domains of GO while oxygen-containing groups have not a substantial effect on the adsorption of this duplex. Using MD simulation adsorption of short and relatively long oligonucleotides on Gr is considered. The difference in the interaction energies between nucleobase and nucleotides with Gr in a water environment is discussed.

The inducing of duplex self-structure (A-motif) formed by single-stranded polyriboadenylic acid (poly(rA)) by GO at neutral pH is considered [2]. The proposed mechanism of the A-motif formation due to adenine's protonation by oxygen-containing GO groups involved in the protonation is discussed. The adsorption on GO of the previously prepared A-motif under acidic conditions was also considered [3]. Particular attention is paid to the features of the adsorption of poly(rA)·poly(rU) and A-motif on GO, and their stability on the surface of GO is compared.

The observed transformation of the structure of a relatively long duplex at adsorption on Gr/GO can be useful in the development of new genesensors, nanomachines based on the structural features of RNA/DNA, nanoscale scaffolds for drug delivery, and other applications in nanomedicine.

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