Functionalization of CVD-graphene controlled by QCN for the development of biosensing platforms

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Recently, carbon-based nanomaterials have provided an interesting approach for bioanalysis platform. Among them, graphene has attracted great attention in bioanalysis applications due to its remarkable electronic structure and high surface to volume ratio which contribute to the high sensitivity of graphene-based sensor devices [1].
The non-covalent functionalization of graphene with pyrene-based linker molecules brings great benefits, allowing to maintain unaltered the original graphene electronic properties and its low aspecific interactions with biological materials [2].
Although the interaction between aromatic systems and graphite surface has been investigated [3], the interaction mechanism and adsorption behavior of pyrenate amphiphilic molecules on graphene, has been reported in a very few papers.
In this work, we describe a non-covalent functionalization of graphene with a stealth-peptide bearing a terminal pyrene group (Peptide-Py), in view of the development of nanodevices such as tunable biosensor/bioanalyte concentrator. The terminal cysteine residual of the peptide would allow a further attachment of the capture antibody to the functionalized graphene.
Herein, the functionalization of graphene and thus the adsorption process and self-assembly morphology of the system onto nanoscale have been demonstrated both experimentally and by computational methods carrying out simulations to investigate the adsorption of a single molecule of peptide-pyrene on the graphene layer.
Graphene was grown on copper substrates via chemical vapor deposition (CVD) technique [4] and then transferred on Au coated quartz crystals for quartz crystal nanobalance (QCN). CVD graphene was self-assembled with the stealth peptide in flow and the functionalization was monitored by measuring the frequency variation using a QCN. To confirm the functionalization, the samples were characterized with several techniques.
Furthermore, we investigated the possibility to restore the pristine graphene layer applying a ramp of temperature, to allow the re-utilization of the sensor.

Acknowledgments

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References

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Figures

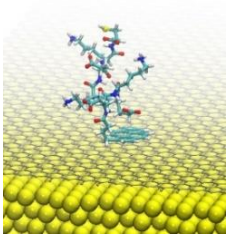

Figure 1. Scheme of the interaction between a single Peptide-Py molecule and graphene on Au/quartz crystal.

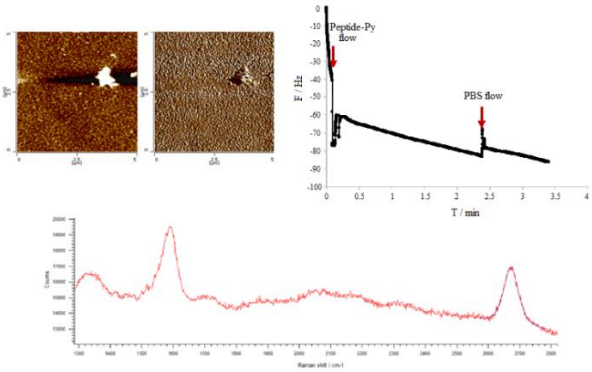

Figure 2. Functionalization of CVD graphene monitored by QCN and characterizations of the functionalized graphene layer.