Mechanical sensor based on functionalized graphene for protein sensing

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AFM-based force spectroscopy has been used for biosensing since it can provide direct visualization and micromechanical characterization of various biomolecules[1]. Here the single layer graphene is non-covalently functionalized by pyrenyl maltose via π−π interaction between pyrene rings and graphene, while the maltose group performs as the sensing probe for the protein molecules, Concanavalin A (Con A) [2]. In this sensing process, the mechanical properties and morphology of graphene is detected by the AFM (Figure 1).

We find part of pyrenyl-maltose molecules aggregate as nanoparticles on the surface of graphene. And the isolated molecules self-assemble densely on the graphene surface which is observed by STM. Due to the specific recognition between maltose and Con A, the functionalized graphene exhibits the selective absorption of the protein molecules sensing. The functionalized graphene shows obvious difference of the adhesion force between detecting with Con A and BSA (control experiment). In summary, the functionalized graphene is fabricated as a simple and effective mechanical sensor for the protein sensing.

References

[1] Li, Q.; Zhang, T.; Pan, Y.; Ciacchi, L. C.; Xu, B.; Wei, G. RSC Advances 2016, 6, 12893.

[2] Cummins, B. M.; Garza, J. T.; Coté, G. L, Analytical Chemistry, 85(2013), 5397.

Figures

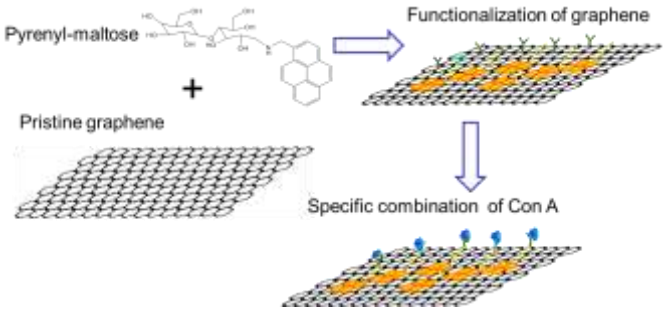

Figure 1: The schematic figure of the sensing process by pyrene-maltose functionalized graphene.

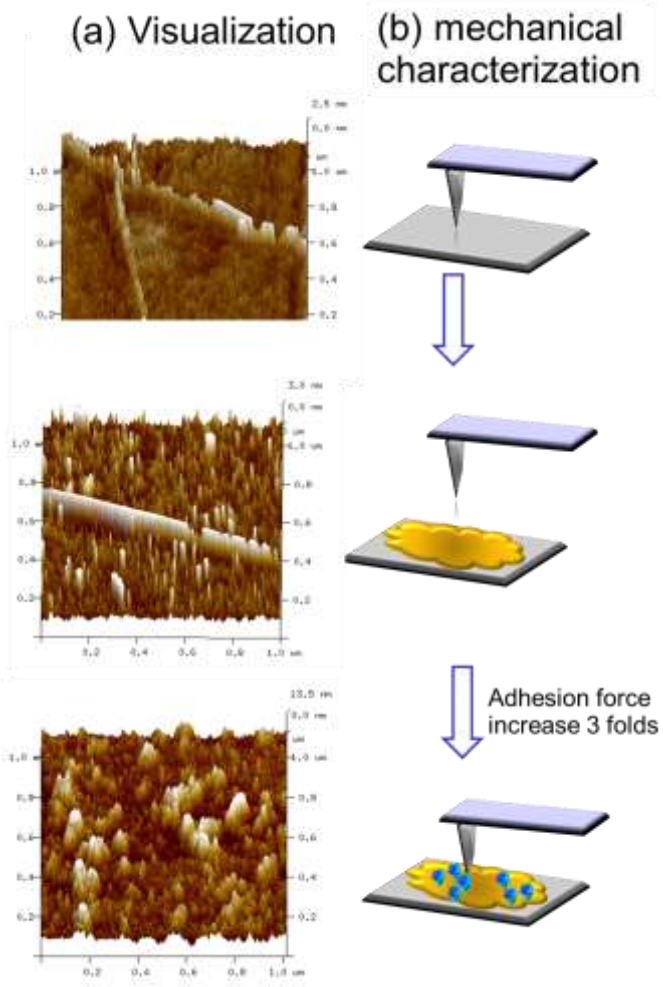

Figure 2: The AFM height 3D images of (a) from top to bottom: pristine graphene, functionalized graphene, Con A molecules on functionalized graphene (b) schematic figure of AFM micromechanical measurement.