Optical and electronic sensing of small molecules by aptamer-modified graphene

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Small molecule (SM) detection has gained increasing interest in the last years in various areas of science and technology. Understanding the fundamental mechanisms of binding kinetics in molecular biology, as well as accurate and rapid diagnostics of contamination in environmental, health, agriculture, and food control, demand for new methods of detection of molecules with sizes less than 1 kDa. Among the small molecules, drugs, pesticides, and toxins are of particular interest.
A number of aptasensors have been demonstrated to be highly specific to SMs due to strong binding with designed aptamers. The graphene-based aptasensors provide a low-cost, scalable, and highly sensitive technology for detection of small molecules [1]. While the general principle of graphene-based biosensors has been investigated, the understanding of microscopic effects is still challenging for SM detection. While SMs are more than 10 times smaller than aptamers, the main effect on graphene properties modulation may lay in the electrical and structural interactions of aptamer and graphene.
In this work, we have developed the aptasensors based on the spectral phase interferometry [2] and graphene field-effect transistors [3] for real-time detection of mycotoxin molecules. We have investigated the optical and electrical changes in graphene during detection of the increasing concentrations of ochratoxin A (OTA). The insight of the principle of aptamer reconfiguration and its interaction with graphene upon binding of the OTA molecules is discussed (Figure 1a). The high sensitivity and reproducibility of the sensors have been demonstrated (Figure 1b).
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References

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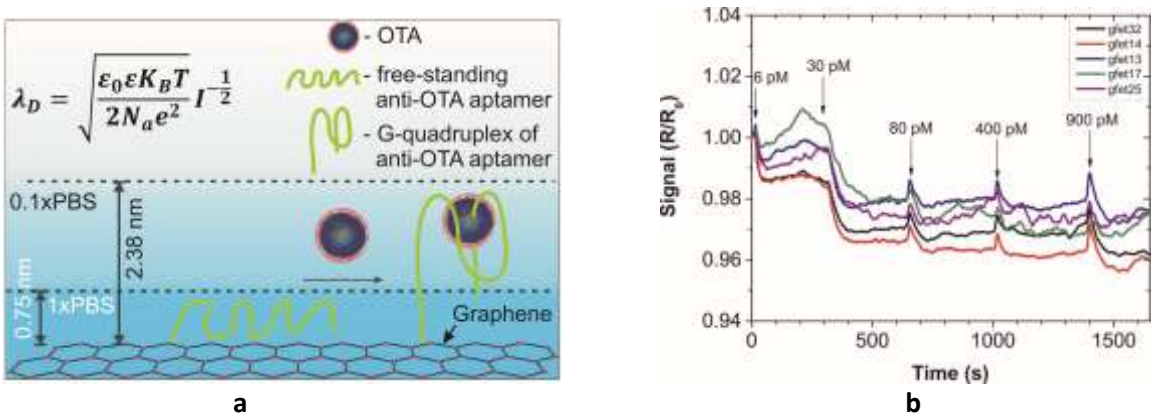
Figures



a **b**

Figure 1: (**a**) Hypothesized mechanism of anti-OTA aptamer target-induced reconfiguration close to graphene channels with different ionic strength. (**b**) Time course of response of an array of five GFET sensors under increasing OTA concentration in 1xPBS.