27p-G12-44

CVD 合成グラフェンを用いたセンサアレイ

Sensor Array Based on CVD-synthesized Graphene

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The monolayer of hexagonally packed carbon atoms named graphene has been known for its remarkable mechanical and electronic properties which have triggered a tremendous potential in the application of sensors. [1] As compared to mechanical-exfoliation graphene, chemical vapor deposition (CVD)-synthesized graphene is a promising method in synthesizing large-scale area of graphene thus offers an advantage of controlling the size and the position of graphene. This contributes to the fabrication of graphene field-effect transistor (FET) array for chemical and biological sensing.

The graphene sheet was synthesized by CVD on a copper/sapphire substrate [2] and then was transferred onto a Si substrate with 300-nm-thick thermally grown SiO_2 layer for the sensing application. The source and drain electrodes were formed by the conventional photolithography and lift-off method. The characteristics of the device were evaluated by detecting immunoglobulin E (IgE) and DNA target using the graphene FET array chip. For experimental setup, we attached silicone chamber to the substrate and used Ag/AgCl electrode as reference electrode. Firstly, anti-IgE aptamer and DNA-probe were separately immobilized onto the graphene channels using 1-pyrenebutanoic acid succinimidyl ester (linker) on the same chip. The sensing characteristics of this device were measured in real time using a semiconductor parameter analyzer. For IgE detection, the drain current increases after the introduction of IgE (Fig. 1), indicating that the IgE molecules were detected by the aptamer-modified graphene-FET. Similar result was observed for DNA detection (Fig. 2) indicating the target DNA was detected by the probe-DNA-modified graphene FET. These results show that the multi target biomolecules can be detected by the CVD-synthesized graphene FETs on the same chip and the CVD-synthesized graphene is useful for the fabrication of multiplex hand-held chemical and biological sensors.

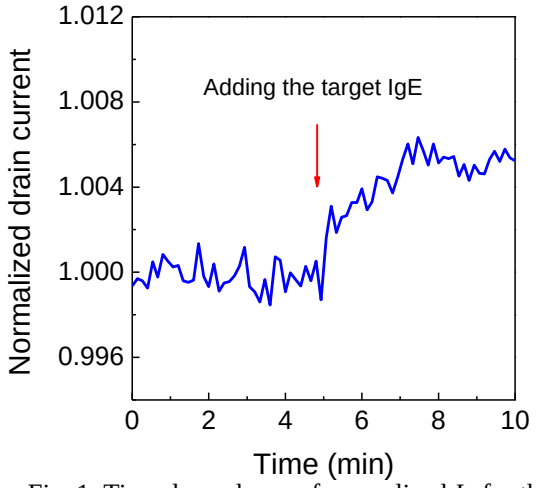

Fig. 1: Time dependence of normalized I_D for the target-IgE detection.

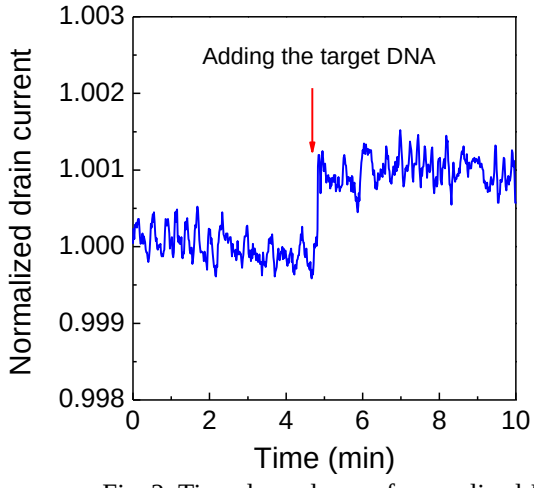

Fig. 2: Time dependence of normalized I_D for the target-DNA detection.

[1] S. Okamoto et al. JJAP **51** (2012) 06FD08. [2] C. M. Orofeo et al., Carbon **50** (2012) 2189.