Sensitive Detection of Influenza Hemagglutinin Using G-Quadruplex DNA Aptamer-Modified Graphene FET Biosensors

Kenzo Maehashi
Hinako Nakamura
Tokyo University of Agriculture and Technology, 2-24-16, Naka-cho, Koganei-shi, Tokyo 184-8588, Japan
maehashi@cc.tuat.ac.jp

Early diagnosis of viral infections and monitoring of airborne viruses are important for medical treatment and epidemic prevention. Graphene-based biosensors are promising due to their high carrier mobility and strong surface sensitivity. In this study, DNA-aptamer-functionalized graphene field-effect transistors (G-FETs) were developed for the electrical detection of hemagglutinin (HA), a key biomarker of influenza virus.
G-quadruplex-forming DNA aptamers were immobilized on graphene channels to fabricate the G-FET biosensors. Upon HA binding, the transfer characteristics exhibited a clear negative shift in the Dirac-point voltage (Fig. 1(a)), indicating charge modulation on the graphene surface. The DP shift was significantly larger than that obtained with DNA lacking the G-quadruplex structure (Fig. 1(b)). Furthermore, HA introduced as fine sprayed droplets also produced measurable electrical responses (Fig. 2). These results demonstrate that aptamer-modified graphene FETs enable sensitive electrical detection of viral biomarkers and provide a promising platform for rapid virus sensing.

Figures

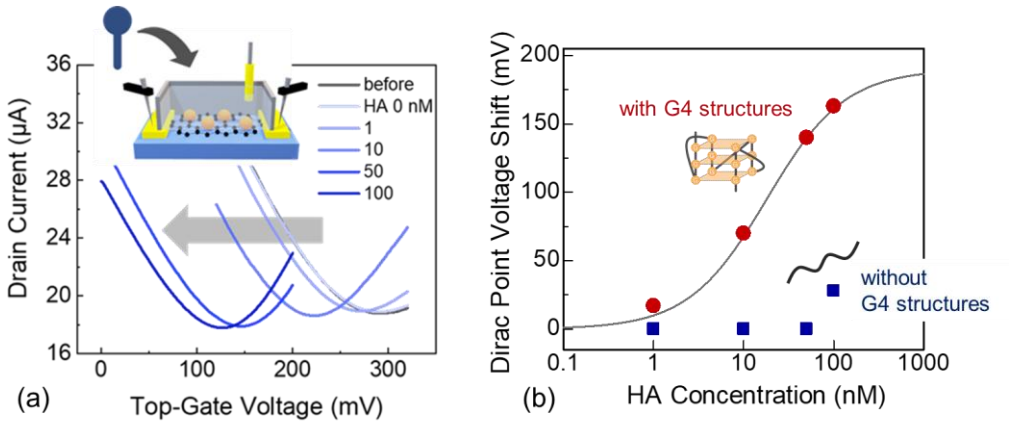

Figure 1: (a) Transfer characteristics after introduction of HA, and (b) DP voltage shift on HA concentration

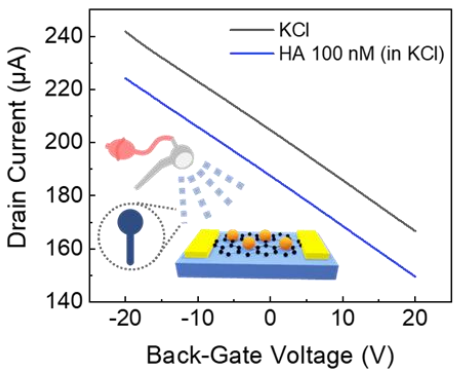

Figure 2: Transfer characteristics before and after spraying HA solution.