Functionalization of Graphene for Bio-Electronic Sensor Application

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The avian influenza virus which can infect to human has the highly pathogenic and quite dangerous. We should know whether the avian virus has the human infection or not. In the present study, we have succeeded in detecting the human infection within 20minutes with ~100 virus using the high sensitive graphene FET.

The surface of the cell for human and avian is covered by the sugar chain. The structure of the sugar chain for human and avian which cover the cell has the difference at the end of their structures, i.e., for the human sugar chain, sialic acid is connected to the α 2-6 galactose, and for the avian sugar chain, to the α2-3 galactose as shown in Fig. 1. Influenza virus recognize this structural difference and the human and avian influenza virus connects to the each sugar chains. The human sugar chain was modified on the surface of graphene FET to selectively detect the human infection of virus.

Before and after the introduction of the virus in the phosphoric buffer solution in Fig.2, the I-V characteristics of graphene FET was measured and the shift of the Dirac point of 32.6mV was observed. This is because the virus has a minus charge and the positive current of graphene FET increases and the Dirac point shifts to the right hand side. This means the detection of the virus using the graphene FET was succeeded in. Figure 2 also shows the AFM image of the graphene surface after the introduction of the virus. On the surface of graphene, several protrusions are observed and its height is ~70nm which almost coincident with that of the virus of ~100nm. About 120~150 virus were confirmed on the channel of the graphene FET.

Figure 3 shows the portable measurement system for the graphene FET by the courtesy of Murata cooperation. Furthermore, the micro TAS system and the automated liquid delivery system was integrated. Using this system, the new Colona virus was successfully detected by the antigen modified graphene FET even in the saliva sample.

Using the sugar chain modified graphene FET, we have succeeded in the selective detection of the human infective influenza virus within 20 minutes. The automated measurement systems were fabricated, and new Colona virus was detected from the saliva sample.

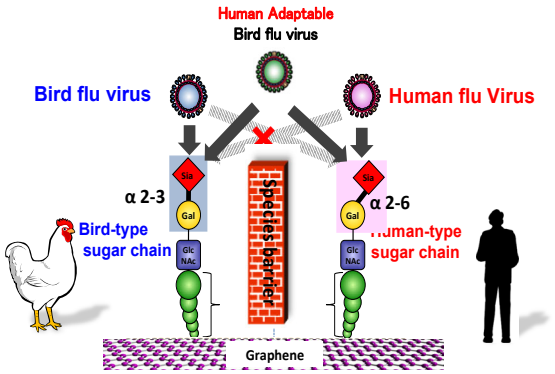

Fig.1, Relation between Avian & Human Flu virus and each sugar chain structures.

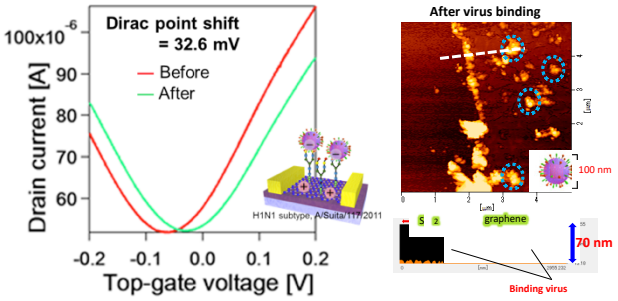

Fig.2, Dirac point shift by introduction of negatively charged virus, and AFM image of virus on graphene surface.

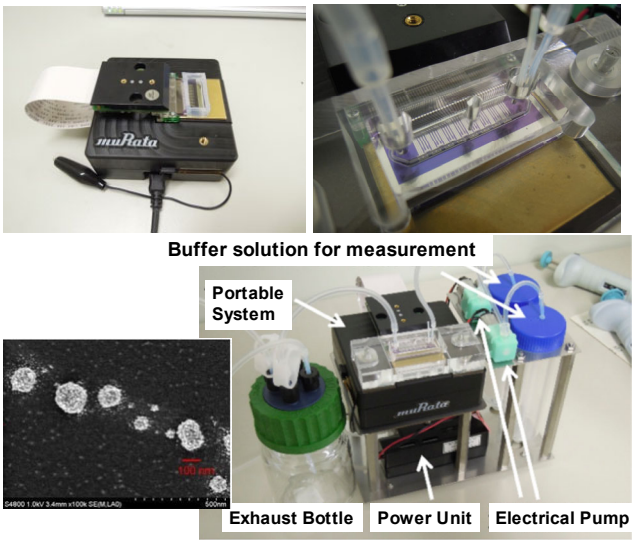

Fig.3, Portable measurement system, micro TAS system and automated liquid delivery system. SEM image of new Colona virus on the antigen modified graphene FET.