Evaluation of the bio nano-sensing probe fabricated by FIB-CVD for the single organelle analyzing

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To understand the biological phenomenon more, it is necessary to operate and analyze single organelle in high accuracy, as shown in Fig. 1. Bio nano-tools are very useful and important tool to achieve the operation and analysis of single organelle. For an example, chloroplast is important organelle for the plant cell to carry out photosynthesis. If biological phenomenon in the chloroplast can be understood more, we will be able to apply those biological mechanisms to the devices such as a solar battery. Therefore, we have been studying about bio nano-tools with the three-dimensional (3-D) structures fabricated by using the focused-ion-beam chemical-vapor-deposition (FIB-CVD). FIB-CVD is a key technology for 3-D structure fabrication. Thus far, some bio nano-tools for operating single organelle are developed by FIB-CVD on the top of the glass capillary. And, we have achieved to take out the chloroplast from the cell using a bio nano-tool fabricated by FIB-CVD. After this, the bio nano-sensing probe is required to measure local biological phenomenon in the chloroplast that was taken out from the cell.

In this study, evaluation of the bio nano-sensing probe fabricated by FIB-CVD was carried out. Figure 2 (a) shows scanning electron microscope image of the bio nano-sensing probe fabricated by FIB-CVD. Diamond-like carbon (DLC) probe was fabricated on the glass capillary having Au electrode, as shown in Fig. 2 (b). And, SiO_2 thin film as an insulator layer was fabricated by RF sputtering. After then, tip shape of the probe was controlled by FIB-etching, and DLC probe inside the SiO_2 probe was exposed. DLC probe has the conductivity as an electrode, because the electrical resisitivity of DLC deposited by FIB-CVD was 3.1 Ωcm. Evaluation of the bio nano-sensing probe was carried out using the cell of *Egeria densa*'s leaf, as shown in Fig. 3. And, we confirmed that the current induced by membrane potential was could be measured using the bio nano-sensing probe, as shown in Fig. 4. This result indicated that the bio nano-sensing probe was useful for the single organelle analyzing. We will report on the operation and analysis of single chloroplast using bio nano-tools fabricated by FIB-CVD.

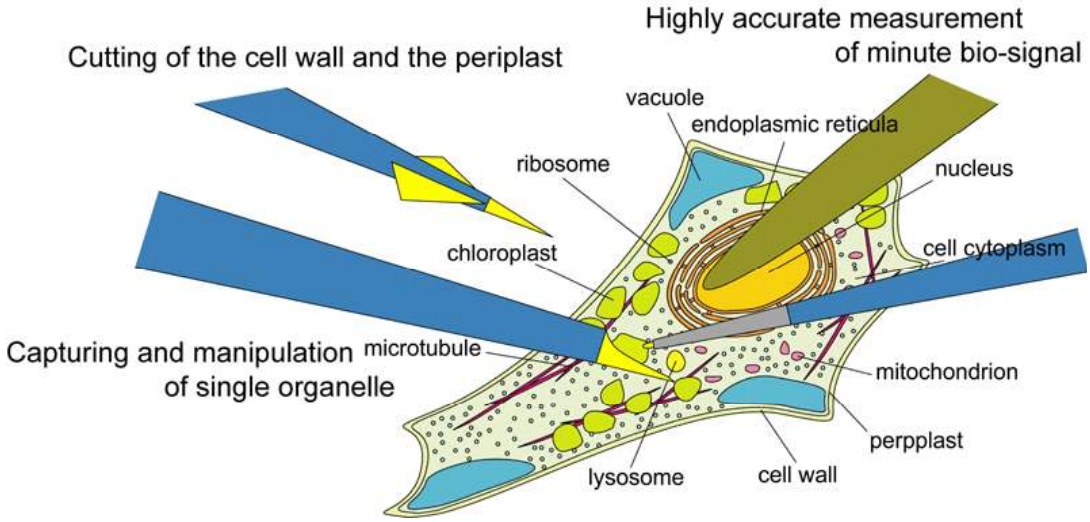
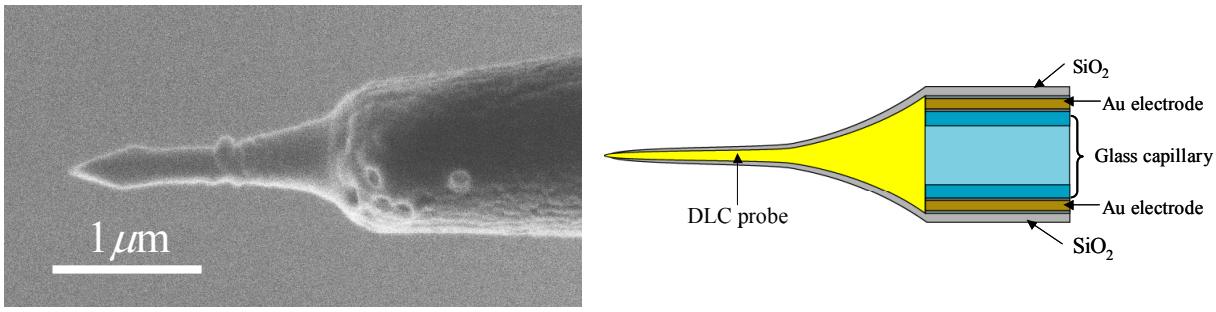


Figure 1 Schematic diagram of the operation and analysis of single organelle using bio nano-tool fabricated by FIB-CVD



(a) (b)

Figure 2 Bio nano-sensing probe fabricated by FIB-CVD
(a) SEM image of the bio nano-sensing probe fabricated by FIB-CVD
(b) Cross-section diagram of the bio nano-sensing probe structure

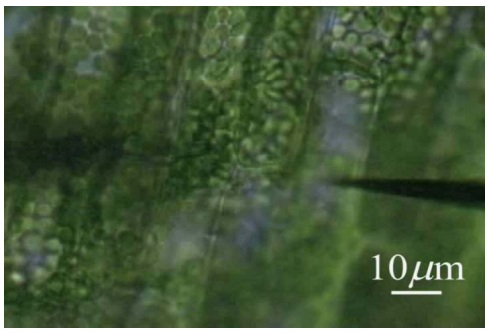


Figure 3 Optical microscope image of the evaluation test for the bio nano-sensing probe

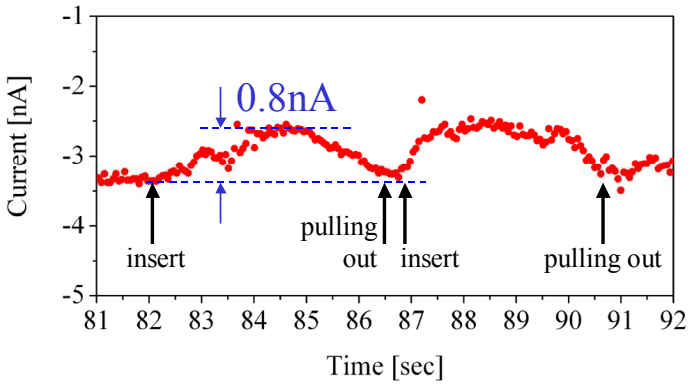


Figure 4 Measurement result of the current induced by membrane potential using a bio nano-sensing probe