MERIT　Self-conduct Collaboration Project　　　　　　　　　Yasutoshi Jimbo

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２．**Individual roles**

Yasutoshi Jimbo: Fabrication and characterization of electronics

Takashi Ohya: Differentiation and cultivation of cells

３．**Period**

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４．Project：hiPSC cardiomyocyte monitoring by organic electrochemical transistors

__Abstract__

The organic electrochemical transistor (OECT) is known as a high current, high transconductance device which can be fabricated on a functional substrates. Unlike conventional Si-based inorganic platform, it can be fabricated by facile processes such as printing. Therefore, many applications have been developed using flexible or soft substrates which enable a conformal contact with bio-tissues.

One of the drawback of using organic transistor platform is the low mobility of channel semiconductor materials. While handling a high-current, it suffers much heat generation. Large area interdigitated electrode is a solution for the problem, but it limits the spatial resolution. Thus, other solution is needed for high-resolution devices such as displays. OECT provides an intrinsic high current owing to the high mobility of the channel material: poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT:PSS).

In this study, we planned to utilize the OECTs for the concurrent stimulation/recording of electrical activity of cardiomyocytes. A simple monitoring of cells have been already reported, but the concurrent operation has not been demonstrated yet. Owing to the intrinsic high driving-current of OECTs, it is expected that cells are stimulated without any external equipment.

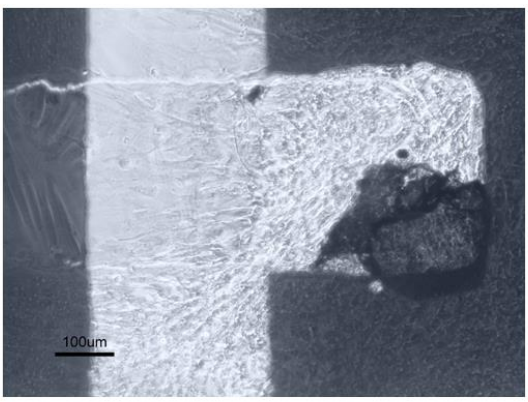
## Results

The insulation layer which covers most of the surface, was coated with a residue of the fluoropolymer sacrificial layer used to pattern the PEDOT:PSS. Due to this residue, the surface exhibited strong hydrophobicity with a water contact angle of ~120°. The PEDOT:PSS channel, on the other hand, is hydrophilic with a water contact angle of ~60°. It can be further hydrophilized to ~20° by removing dodecyl benzene sulfonic acid (DBSA) which is mixed to stabilize the film formation.

It is well known that the surface adsorption of biomolecules is greatly affected by the degree of hydrophilicity. In this study, fibronectin was coated on the surface to make the cells adhere to the surface, and the substrate of fibronectin was affected as well. Therefore, the following treatments were performed to make the samples hydrophilic.

- Removing DBSA from PEDOT:PSS
- Washing the surface out with a fluorine-solvent
- Hydrophilizing the surface by UV ozone

Figure 1 (left) shows the sheet of cardiomyocytes cultivated on a hydrophilized surface. Cells were packed successfully with a high density, but it delaminated itself by the shrinking force. The OECT was also severely damaged by this phenomena. Thus we quited using the hydrophilization process. Figure 1 (right) shows the recorded field potential. The interval and amplitude of peaks were consistent with previous works.



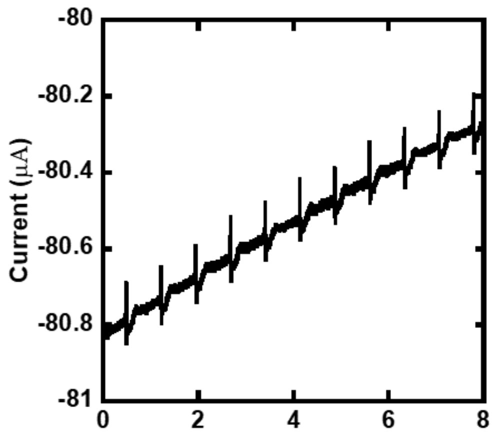




Figure 1 Cardiomyocytes on OECT (left) and recorded potentials (right)

## Future Plan

A paper which includes the data of intracellular recordings is to be submitted.