

## Modification of Plasma-on-Chip Device for Stable Plasma Treatment of Cells

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Low-temperature atmospheric pressure plasmas have been used in biomedical field [1]. We have been developing a MEMS device for irradiating cells cultured in liquid medium with low-temperature atmospheric pressure plasma [2,3]. The MEMS device referred to as “Plasma-on-Chip” can be used to activate or inactivate single cells cultured in microwells by plasma irradiation. Here, we report three topics: modification of plasma-on-chip device, demonstration of the reactive species delivery into the microwell, and plasma irradiation against biological sample.

### 1. Development of single-well plasma-on-chip

The Plasma-on-Chip device was modified for stable plasma treatment. First, a Plasma-on-Chip device with a single well was fabricated using MEMS technology. Second, a plasma source was covered with an insulator layers to reduce the damage during plasma generation. The covered structure corresponded to dielectric barrier discharge (DBD) plasma source. The DBD plasma source worked well to extend the continuous device operation time up to 3 min.

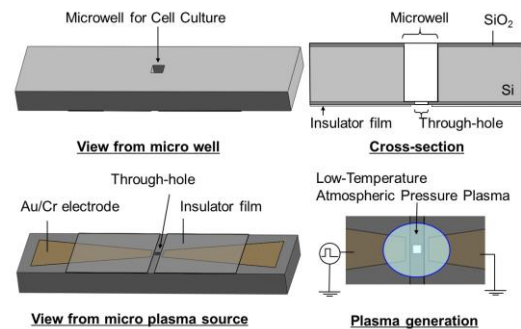


Fig.1: Single-well plasma-on-chip.

### 2. Demonstration of the reactive species delivery

To demonstrate the reactive species delivery to the microwell, a simple experimental setup was developed. A Si chip with through-holes were fabricated. Pure water including methyl red was put on the Si chip and the backside of the Si chip was irradiated with atmospheric pressure plasma jet. After the plasma-irradiation, the color of the methyl red changed. It was shown that the reactive species were delivered through the through-holes.

### 3. Plasma irradiation against biological samples

We used green algae, *Chlorella* cells. *Chlorella* cells suspension ( $1.4 \times 10^4$  cells/ $\mu$ l) was poured into the microwell of the Plasma-on-Chip. After the plasma irradiation, the *Chlorella* cells were observed by fluorescence microscopy. The plasma irradiation decreased the fluorescence intensity which was derived from the Chlorophyll in the *Chlorella* cells.

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