9th Asia-Pacific Conference on Plasma Physics, 21-26 Sep, 2025 at Fukuoka

A micro perfusion system for promoted cell growth using plasma exposure through micro air-liquid interface

Shinya Kumagai[1],
[1] Meijo University,
e-mail (speaker): skumagai@meijo-u.ac.jp

Plasma technology is now creating innovation in life science. Non-thermal plasma generated under ambient conditions can produce reactive oxygen and nitrogen species (RONS) which can trigger cells' reaction. Plasma life science researchers use plasma-generated RONS for controlling cells' viabilities [1].

On the other hand, micro electromechanical systems (MEMS) researchers have developed microperfusion system for simulating in-vivo conditions which are suited for cell growth [2].

Nowadays, promoted cell growth is strongly demanded in medical treatments for forming cell sheets, spheroids and organoids. Those are indispensable for conducting research of regenerative medicine and drag screening. However, forming cell sheets, spheroids, and organoids are time-consuming.

To overcome the above issue, we fused plasma and MEMS technologies for advancing cell culture technology using plasma [1].

Structure of our microperfusion system sis shown in Fig. 1. To deliver plasma-generated RONS to cells cultured under microperfusion, a microgap is created at the bottom of a microchannel. When liquid medium is supplied into the microchannel, surface tension of liquid medium forms air-liquid interface at the microgap and liquid medium flows inside the microchannel without leakage. Under the microgap, a plasma source is set.

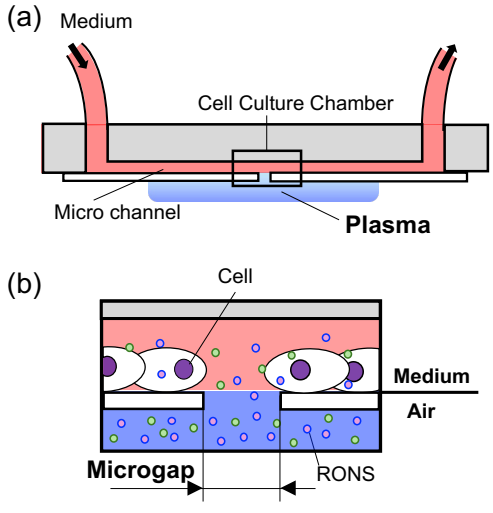

Fig. 1 (a) Structure of microperfusion system using plasma exposure. (b) Magnified drawing of cell culture chamber.

When a plasma is generated, RONS can enter into the microchannel through air-liquid interface.

Murine myoblast cells C2C12 were seeded into the microperfusion system and cultured. Our microperfusion system achieved stable culture of C2C12 cells and differentiation into myotubes.

To analyze plasma effects, we conducted Ca^{2+} imaging of C2C12 cells cultured under microperfusion. Propagation of plasma stimulation effects derived from RONS were observed.

Acknowledgements
This study was partially supported by the Takahashi Industrial and Economic Research Foundation, and the joint research program of the Center for Low-Temperature Plasma Sciences (cLPS), Nagoya University, and research promotion program in Meijo University.

References

[1] M. Kobayashi et al., Heliyon, **8**, e12009, (2022).
[2] M.L. Coluccio et al., Microfludic Engineering, **208**, 1, pp14-28, (2019).
[3] H. Okino, at al., Jpn. J. Appl. Phys 62, SG1043 (2023); DOI 10.35848/1347-4065/acc03c