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論 文 内 容 の 要 旨
Abstract of Dissertation

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Biocompatible material polydimethylsiloxane (PDMS) is generally used to culture cells for development of new types of drug screening, modelling and investigation of diseases, gene editing, and benefits of recovering medicines. A way for improvement of PDMS wettability has been reported by using low-pressure plasma irradiation with mask. This way leads to obtain in order of used mask sizes. However, the low-pressure plasma is not suitable for simplifying process such as the difficulty to change the pattern sizes and the requirement of expensive vacuum pumps. To overcome these issues, this study investigates the use of atmospheric pressure plasma jet (APPJ) instead of the low-pressure plasma source for plasma patterning.

To achieve these objectives of this study, it was considered the electrode configurations of APPJ. The results showed that the double electrode configuration provided a longer APPJ. The double electrode configuration with an additional pin electrode was also demonstrated. It indicated that the plasma jet length lengthened with the additional pin electrode setting to the grounded voltage. Compares to the parallel electrode, double electrode APPJ with and without grounded additional pin electrode increase the plasma jet length along with the radical generation. Variance in plasma jet with radical generation and propagation of these APPJs were investigate against the capillary tube diameter, gas flow rate, and applied voltage to identify the optimal conditions for the plasma patterning. Optimal APPJs were used to make plasma patterning on PDMS surfaces for cell culture with and without a mask.

Using the APPJ, we successfully achieve the mask free plasma patterning and cell cultivation on treated surfaces. Wetting area depends on the irradiation time as the cell culture area is equalling to the wetted area. As expected, the APPJ provides the radicals on the PDMS surfaces in a similar of the low-pressure plasma irradiation. Mask free plasma patterning for cell culture also successfully achieved using these APPJ sources. Even though, the tube diameter, the gas flow rate, and the applied voltage affects to change the plasma jet length with radical's generation and propagation, the pattern sizes did not affect these parameters to control the mask free plasma patterning. The use of mask with plasma irradiation using these APPJs was able to achieve the plasma pattern sizes in few hundred micrometers which were lower than the mask size for the shorter irradiation time.

Our findings in this study confirms, APPJ can be used as an alternative approach to modify the PDMS surfaces and approaching a mask free patterning. The control of the pattern sizes depends on the irradiation time and irrespective to the parameters affecting to plasma jet. In addition, the use of masks in millimetre sizes can be achieved pattern sizes lower than the mask sizes with shorter irradiation time.