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Non-Thermal Atmospheric Pressure Plasma for Controlling Cell Fate

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Non-thermal atmospheric pressure plasma (NTAPP) has been used in biomedical research [1-5]. One of the attractive applications is gene transfection for controlling cell fate [6,7]. Compared to conventional gene transfection methods using virus vector, lipofection, or electroporation, non-thermal atmospheric pressure plasma is expected to achieve superior gene transfection without causing damages to cells. Excellent results have been reported but what is happening during plasma gene transfection at each cell has been unclear. In this study, surface morphology of cells upon plasma exposure were analyzed in detail. The plasma-induced surface structure was discussed in terms of gene transfer into cells.

In the plasma gene transfection, cells cultured in a dish is exposed to plasma. Plasma exposure can increase the material permeability of the cell membrane enabling gene transfer into cells (Fig. 1).

To elucidate plasma exposure effects on cell membrane, cells exposed to plasma jet were freeze-dried and analyzed with Scanning Electron Microscope (SEM).

SEM observation revealed that cell membrane before plasma exposure (control sample) had smooth but wavy structures. At the beginning of plasma exposure, conditions of cell membrane were almost the same. With increasing the plasma exposure time, protruded structures formed on the cell membrane. With further increasing, it was found that nanopores formed on the cell membrane.

Towards the gene transfer, substance intake experiment was conducted. Fluorescent reagent of DiYO-1, (molecular weight: 1270) was used. Compared to using plasmid DNA for introduction inside cells, merit of using fluorescent reagent is that introduction of fluorescent reagent can be analyzed easily by fluorescence microscopy without incubating cells for gene expression.

For the cell samples in the beginning of plasma exposure, fluorescence of DiYO-1 was not observed. With increasing plasma exposure time, fluorescent was observed for the cells under plasma exposure conditions of nanopore formation.

Considering these results obtained here, nanopores formed by plasma can play important roles in substance intake.

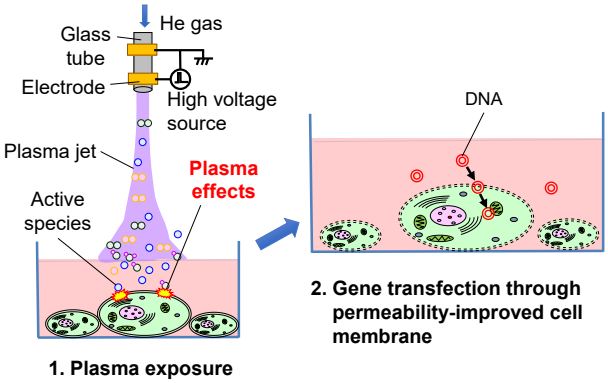

Fig. 1 Plasma gene transfection.

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