

# Surface Modification on Medical Polymer Films Using Remote Microplasma

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## INTRODUCTION

This study introduces the surface treatment of polymer sheet developed for medical use by using microplasma. This sheet is fabricated for the medical use, and the adhesive force is important when is applied on wounds. Microplasma treatment was used in order to improve the adhesive force which is related to the hydrophilic property of the sheet.

### (1) Microplasma Electrodes

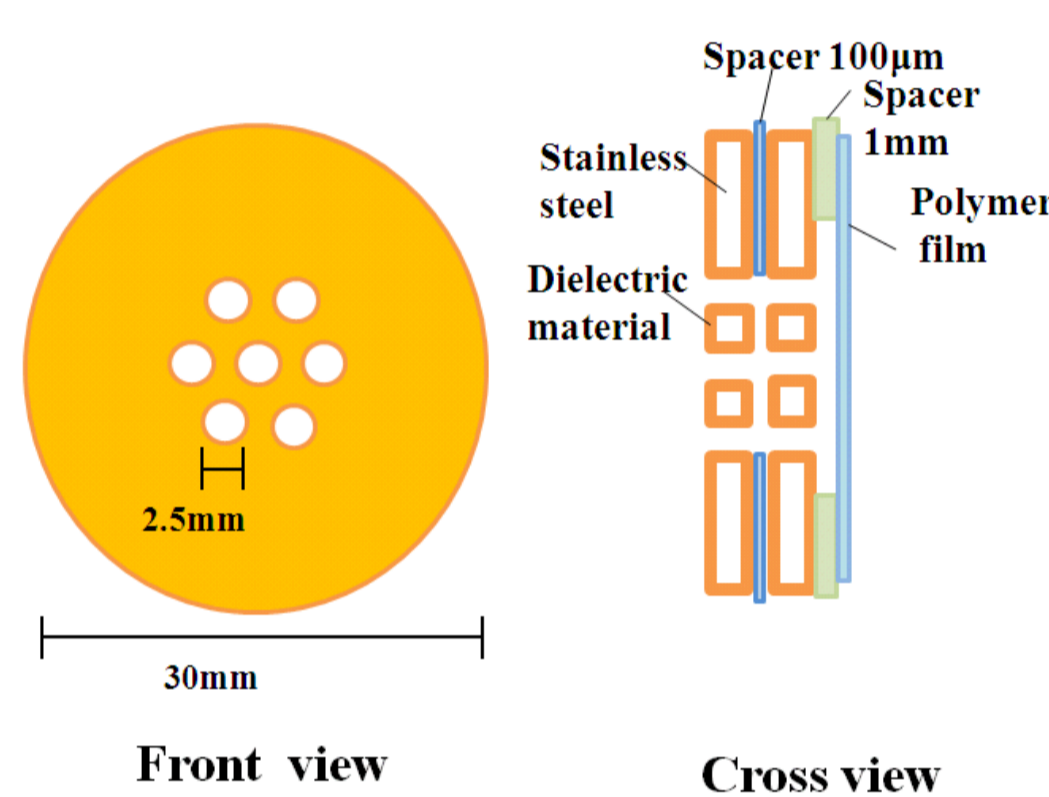


Fig. 1 Microplasma electrodes.

Perforated metal plates covered with dielectric layer were used as a electrodes. A spacer with a hexagonal hole with 7mm side was inserted between electrodes in order to increase a gas flow and to secure the desired gap length(Fig. 1).

### (2) Experimental Setup

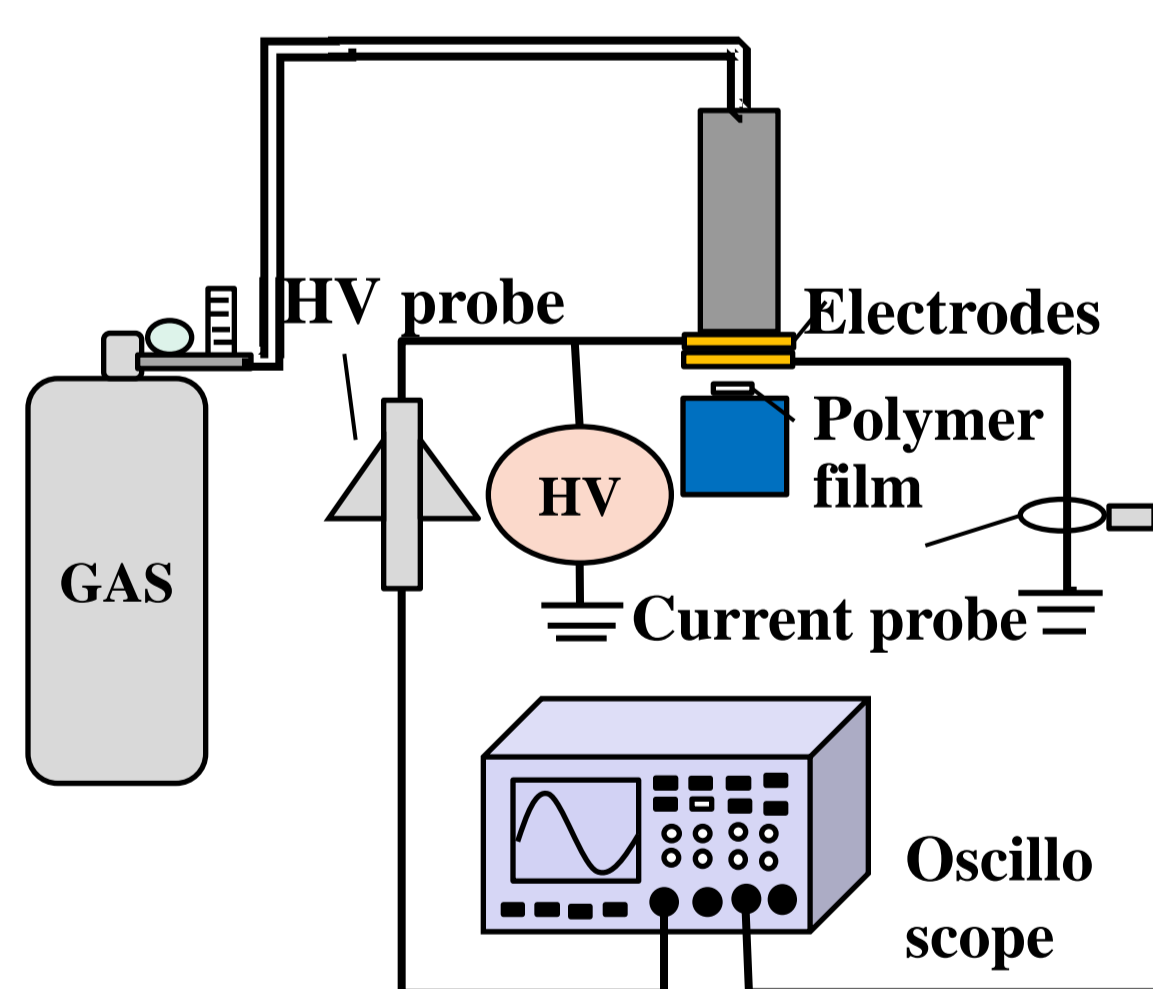


Fig. 2 An experimental setup for surface treatment of polymer sheet. A neon transformer was used as an AC high voltage power supply. Treated polymer film surface modifications were estimated by using XPS, emission spectrometer and a contact angle meter(Fig. 2). These condition are shown in Table 1.

Gas flow rate [L/min]	5
Process gas	Ar,N <sub>2</sub> ,Air
Distance of between electrodes and polymer sheet [mm]	1

## RESULTS

### (1) Relation of Treatment Time and Contact Angle

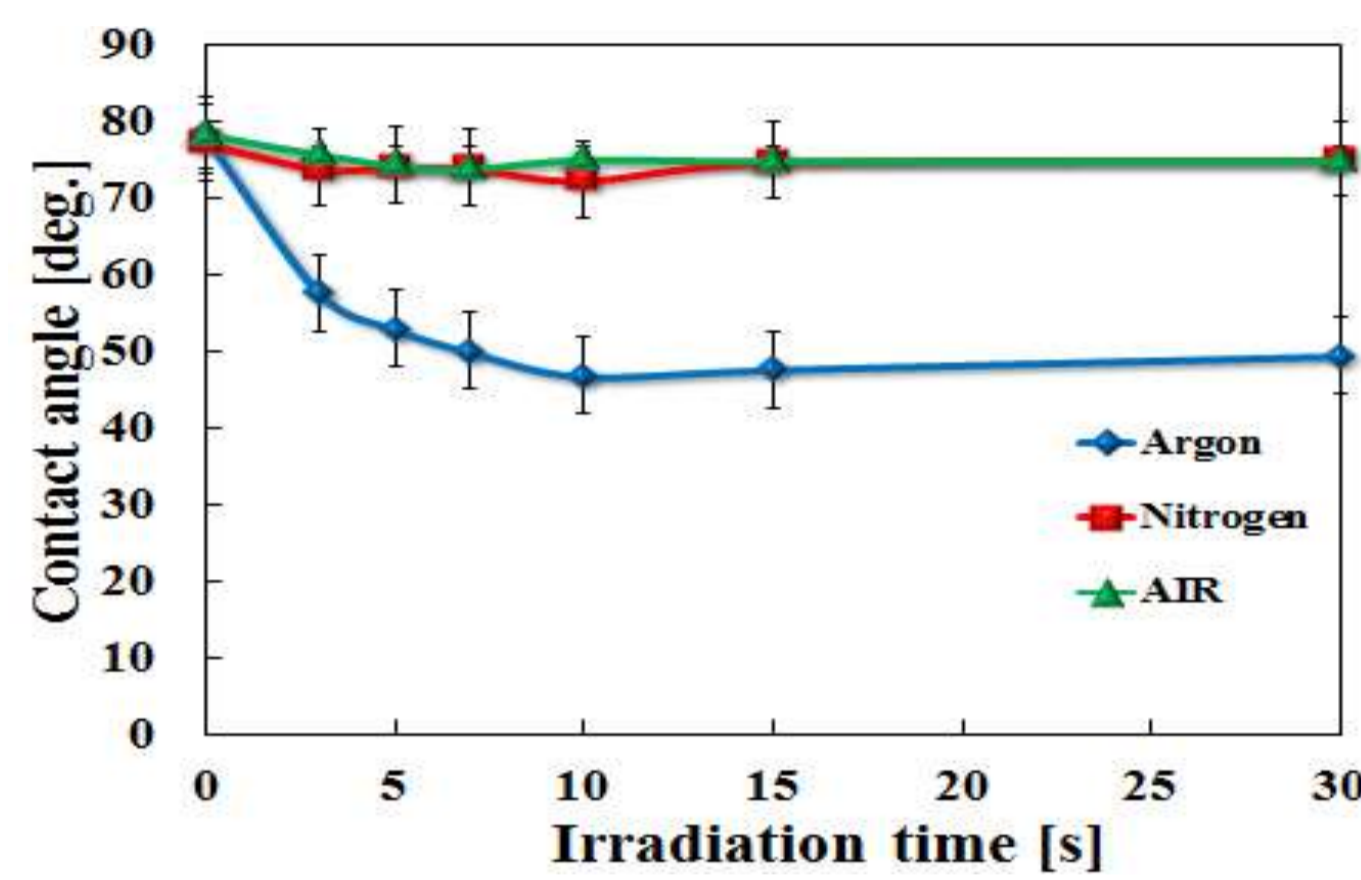


Fig. 3 Treatment time versus contact angle (Using gas is Ar,N<sub>2</sub>, room air).

Table 2 Applied voltage for surface treatment.

Process gas	Applied voltage [kV]
Ar	0.9
N <sub>2</sub>	1.3
Air	1.4

Contact angle was reduced to 30° in 10 seconds using Ar as shown in Fig. 3. Air and N<sub>2</sub> microplasma did not affected so much as using Ar. These condition are shown in Table 2.

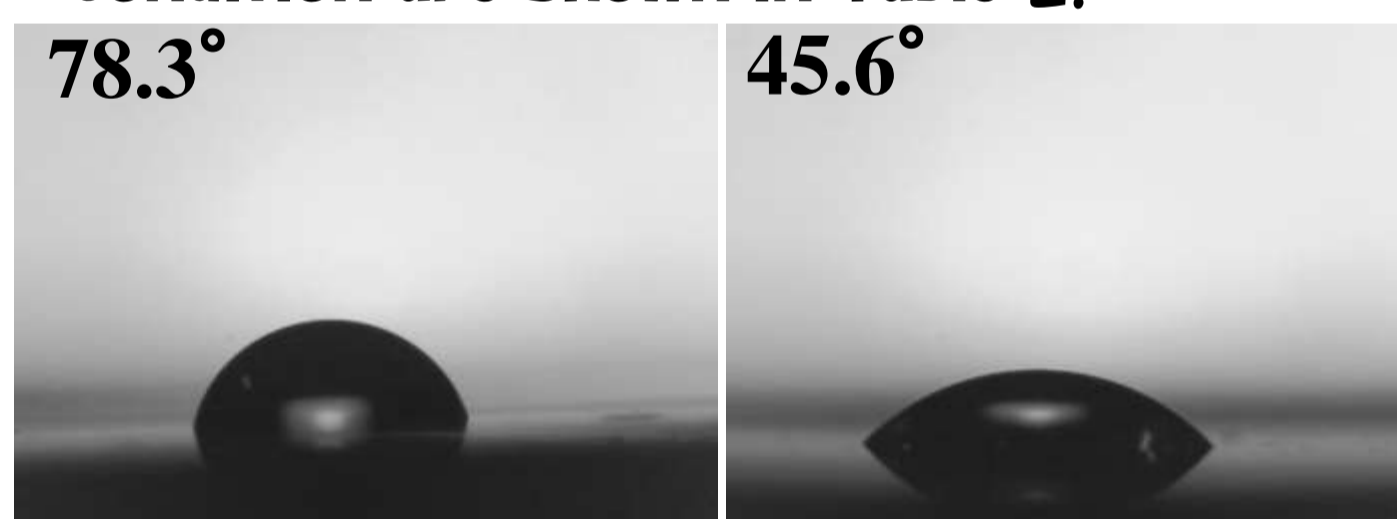


Fig. 4 Image of water droplet on the polymer film.

The water droplet on the surface of treated polymer film changed to a more elongated shape without plasma treatment as shown in Fig. 4.

### (2) Surface Analysis by XPS

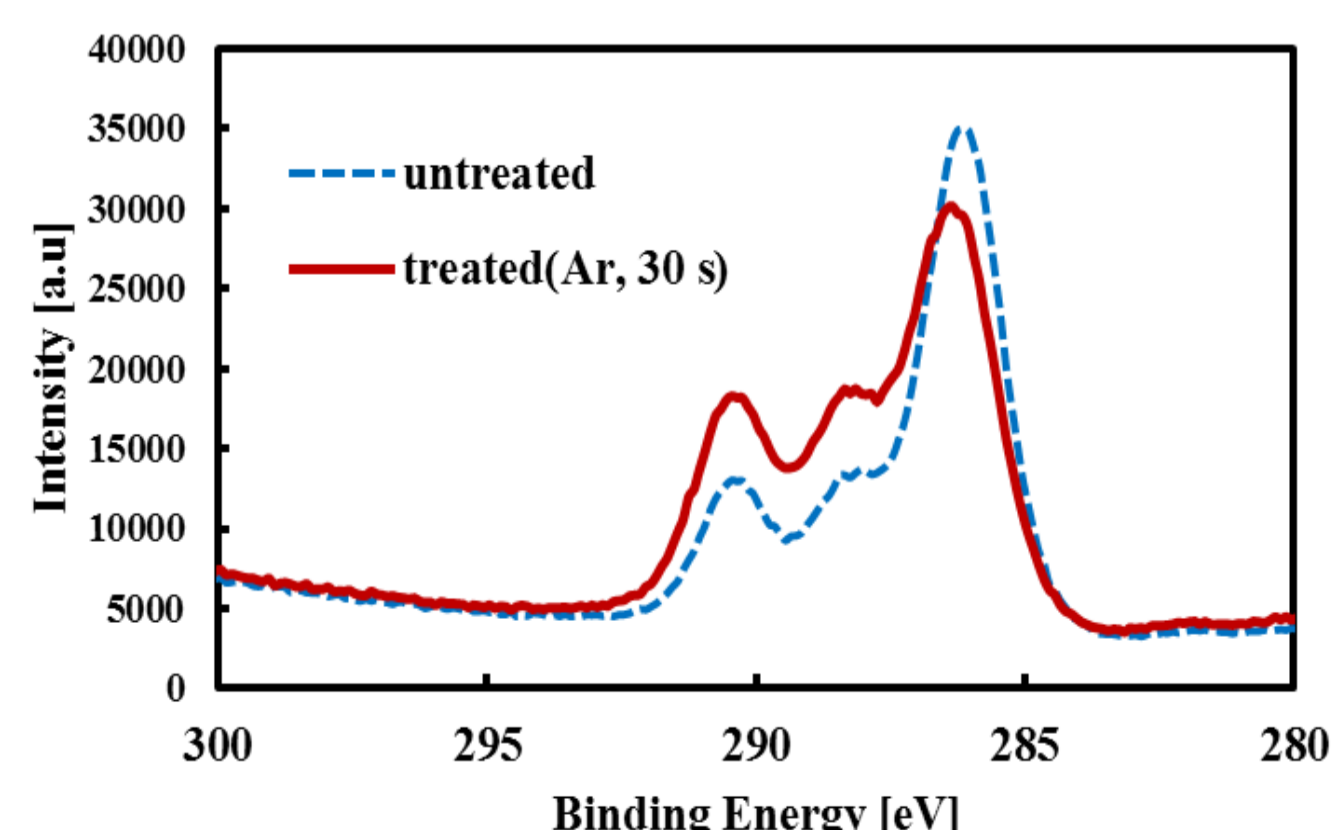


Fig. 5 The XPS spectra of the C1s component (Blue line: Untreated, Red line: Ar plasma treatment ).

The C-C,C-H bond decreased and C-O, C=O bonds decreased compared with untreated polymer films (Fig. 5).

### (3) The depth of treatment by microplasma

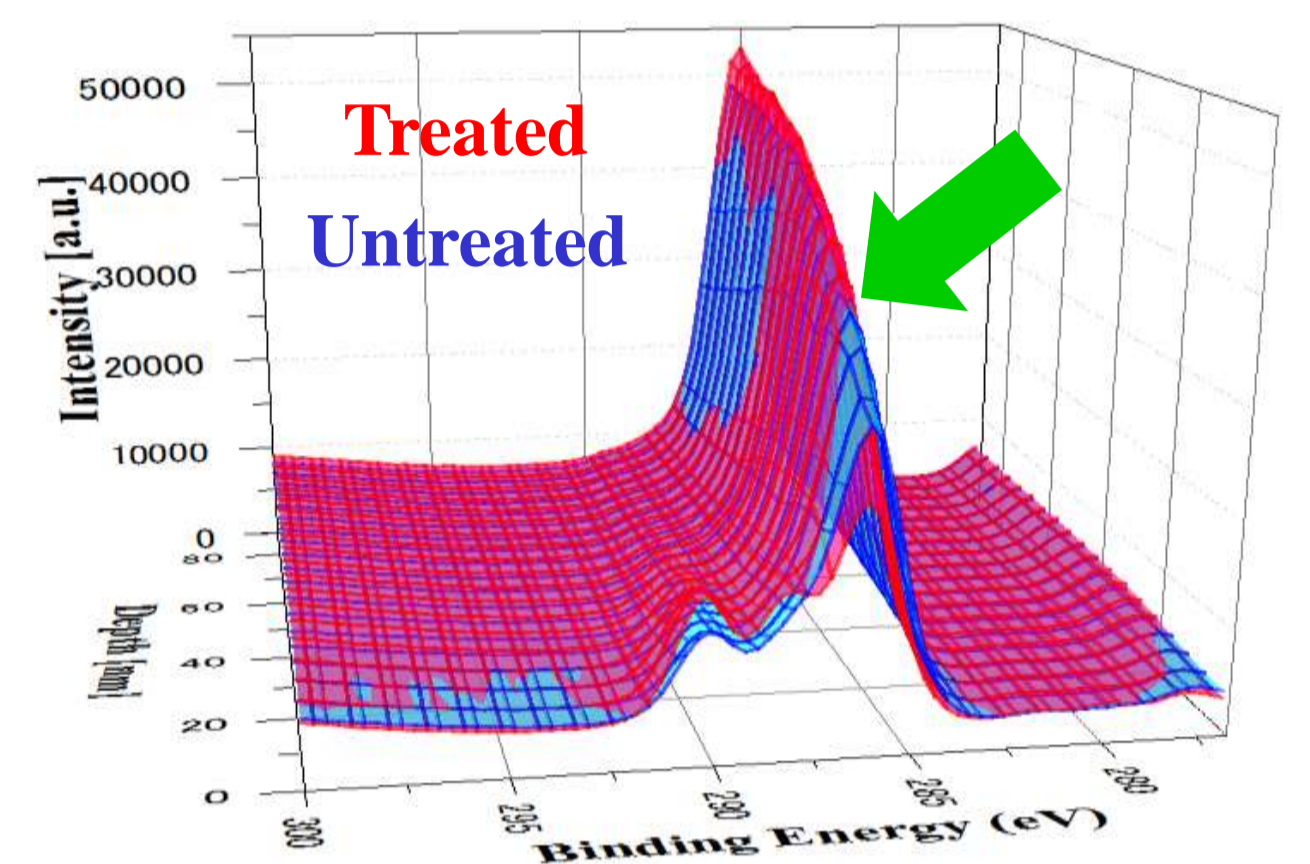


Fig. 6 The depth of modification using microplasma (Process gas: Ar,Treatment time: 15 s, Applied voltage: 0.9 kV).

The depth of surface treatment was measured by XPS. The arrow on the Fig. 6 shows the point which untreated C-C bonds and treated C-C bonds intersect. According to this surface treatment have ended in this point and the depth was about 20 nm.

### (4) The damage of polymer films After microplasma treatment

The Fig. 7 shows the damage image of polymer surface taken by SEM. Surface of treated polymer become harsher compared with untreated polymer surface.

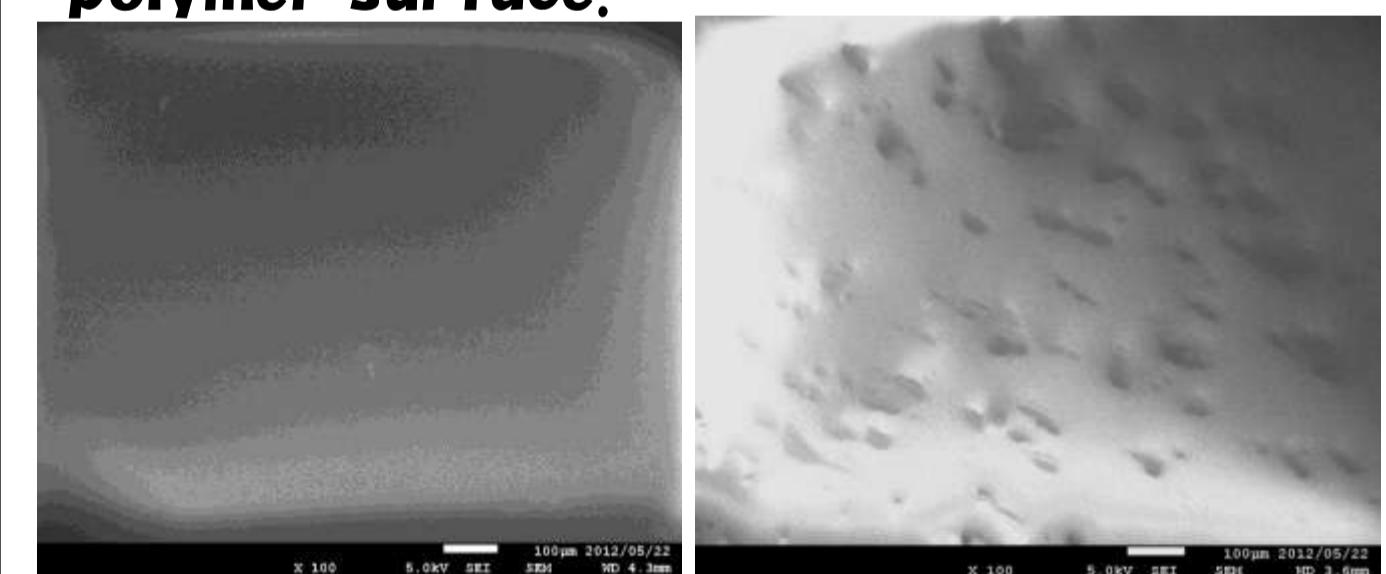


Fig. 7 The SEM image on the polymer film. (The left photo: untreated, The right photo: Ar plasma treatment) Treatment time: 7 s Applied voltage: 0.9 kV.

## CONCLUSIONS

Microplasma treatment for polymer film was carried out.

1. The minimum contact angle decreased to about 45° after Ar microplasma treatment.
2. Hydrophilic group increased and the hydrophobic group decreased after microplasma treatment.
3. The depth of treatment was about 20 nm measured by XPS analysis.