Water contact angle of Poly(dimethylsiloxane) by ion beam irradiation.

Hyuk-Jun Choi*, Jae-Sang Lee, Chan-Young Lee, Yong-Gi Kim
Proton Engineering Frontier Project, Korea Atomic Energy Research Institute,
150-1 Deokjin-dong, yuseong-gu, Daejeon, 305-353, Korea
**E-mail : choihj@kaeri.re.kr*

1. Introduction

The dimethylsiloxane (PDMS) has been extensively utilized in a wide range of academic and industrial applications owing to its strengths such as chemical inertness, non-toxicity, easy handling and commercial availability [1]. Recently, PDMS is widely used in membrane technology, microlithography and micro-fluidic devices of biomedical applications. However, it has been limited to use in versatile applications due to its low hydrophobicity. Thus, the modification of PDMS has been carried out by using a variety of physicochemical methods based on oxidation, composites, and surface coating to enhance its surface and mechanical properties [2]. Ion implantation is one of the useful methods for modifying of polymer surfaces properties.

Ion beam irradiation provides a unique way to modify the mechanical, optical, and electrical properties of polymers by depositing the energy of ions in the material on an atomic scale [3]. Beam irradiation of ions into polymers generally leads to radiation damage, which, in many cases, modifies the properties of the surface and the bulk of the material [4]. These modifications result from changes in the chemical structure caused in turn by changes in the chemical bonding when the incident ions cut the polymer chains, break covalent bonds, promote cross-linking, and liberate certain volatile species [5]. The nature of these changes depends on the properties of the polymer, such as the composition and molecular weight [6]. In this study, we observed the changes in surface by ion beam irradiation.

2. Experimental

Poly (dimethylsiloxane) (PDMS) were irradiated with nitrogen, argon at an irradiation energy of 30 ~ 90keV and a dose range of $1x10^{14}$ ~ $1x10^{16}$ ion/cm^2. The ion current density maintained under 1.5 μA/cm^2 to prevent overheating leading to a melt-down at the polymer surface. Water contact angles were measured with deionized water on a contact angle analyzer (Phoenix 300, Surface Electro Optics Company) at room temperature. Each value of the contact angle was taken as the average value measured from three different samples fabricated under same experimental conditions.

3. Results

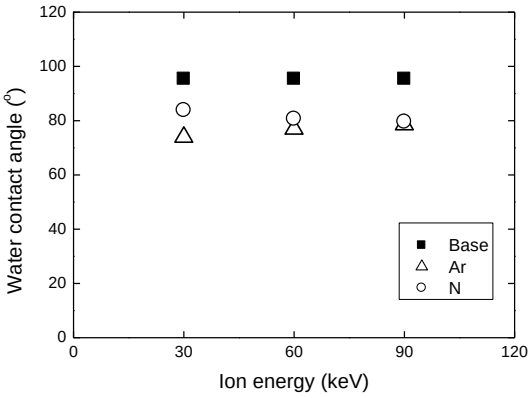

Fig. 1. Water contact angle of PDMS by ion beam energy

We observed the changes in the wettability of the PDMS by nitrogen, argon ion beam irradiation dose at $1x10^{15}$ions/cm^2. The irradiated PDMS were analyzed by contact angle measurements and the results are shown in Figure 1. It can be seen that, the water contact angle of PDMS were measured 96°, the water contact angle of the ion irradiated PDMS with Argon 30keV were measured to be decreased up to 74°.

The general trend was that increasing the nitrogen ion energy increase the water contact angle. However, increasing the argon ion energy decreases the water contact angle.

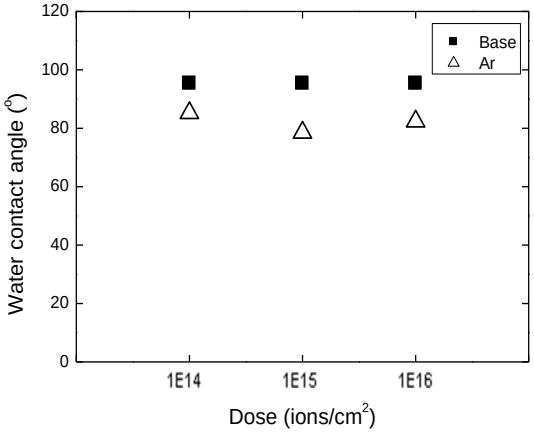

Fig. 2. Water contact angle of PDMS by ion dose

The PDMS were irradiated with nitrogen at 90keV, $1x10^{14}$, $1x10^{15}$, $1x10^{16}$ions/cm^2 and the results are shown in Figure 2. The water contact angle of the ion irradiated PDMS with Argon 90keV $1x10^{15}$ions/cm^2 were measured to be decreased up to 80°.

4. Conclusions

This study provides PDMS with improved water contact angle using ion beam surface treatment.

The general trend was that increasing the nitrogen ion energy increase the water contact angle. However, increasing the argon ion energy decreases the water contact angle.

From certain measurements, it was reported previously that the improvement in surface properties after ion beam treatment. Therefore, it is necessary to experiment of PDMS by ion irradiation

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