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Surface Chemical Reaction Between Polymer(PC and PMMA) and Energetic Ar^+ ion In Oxygen Environment

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Methods of improving wettability of polymer to triple distilled water and adhesion to metal by ion beam techniques have been reviewed, and new surface modification method using by broad ion beam with low energy are suggested[1], in which Ar^+ ions(O_2^+ ions) were irradiated on polymer surfaces under the various oxygen partial pressure. Dose of ions were changed from $5x10^{14}$ to $1x10^{17}$ ions/cm^2 in a range of 500 eV to 1.5 keV energy by Kaufman type ion source[2], which is relatively low energy range compared to a few 10s-100s keV or a few MeV energies previously used in polymer surface modification in ion beam modification. 0.025 ㎖ triple distilled water was dropped at four different places and contact angles of water to PMMA and PC have been measured and averaged by Contact Anglemeter(ERMA, Goniometer Type), in which the wetting angle of PMMA and PC was not much reduced with only Ar^+ irradiation, but it showed remarkable reduction with simultaneous Ar^+ ions irradiation in various oxygen gas flow rate(1 ㎖/min - 6 ㎖/min). In those results, there existed some critical dependence of the wetting angles upon ion beam energy, oxygen partial pressure, and Ar^+ ions dose in both cases. Moreover, even though O_2^+ ions instead of Ar^+ ion was replaced to enhance chemical reaction between polymer and ion beam, however, the change in wettability showed almost same trend with those of Ar^+ ion irradiation. The improved wettability of modified polymer surface are tried to be explained in terms of two-step process[3,4,5], in which the first step is to generate hydrophilic group through bond scissoring, carbonization, and crosslinking caused by ion bombardments , and the second one is the chemical reaction between oxygen and those unstable hydrophilic functional group, and also these phenomena were analyzed by XPS and FT-IR. Furthermore, enhanced adhesion between aluminum thin film and polymer surface treated by Ar^+ ions is identified by Scotch tape and Scratch test.

[1] Applying for U.S. and Korea patents.

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