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Study of PSII-treated PMMA, PHEMA, and PHPMA ; Investigation of Their Surface Stabilities

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The plasma source ion implantation(PSII) technique which is a method using high negative voltage pulse in plasma system has the potential to change the surface properties of polymer. PSII technique increases the surface free energy by introducing polar functional groups on the surface so that it improves reactivity, hydrophilicity, adhension, biocompatability, etc. However, the mobility of polymer chains enables the modified surface layers to adapt their composition to interfacial force. This hydrophobic recovery interrupts the stability of modified surfaces to keep for the long time.

In this study, poly(methyl methacrylate)(PMMA), poly(2-hydroxyethyl methacrylate)(PHEMA), and poly(2-hydroxypropyl methacylate)(PHPMA) for contact lens application, were modified to improve the wettability with PSII technique and were investigated the surface stabilities. Polymer film was prepared with solution casting(3 wt.% solution) and was annealed at 110℃ under vacuum oven to remove solvent completely and to eliminate physical ageing. The thickness of the film measured by scanning electron microscopy(SEM) and surface profilometer was about 10 μm.

Polymers were treated with different kinds of gases, pulse frequency, pulse width, pulse voltage, and treatment time. Even though PMMA, PHEMA, and PHPMA have similar repeat unit structure, the optimal treatment conditions and the tendency to hydrophobic recovery were different. PHPMA, more hydrophilic polymer than PMMA and PHEMA showed better wettability and stability after mild treatment. Surface tensions were obtained by water and diiodomethane contact angle measurements to monitor the relation between hydrophobic recovery and polymer structure. Different ion species in plasma change the polar component and dispersion component of polymer surface. For better wettability surface, the increase of polar component was a dominant factor. We also characterized modified polymer surfaces using x-ray photoelectron spectroscopy(XPS), secondary ion mass spectrometry(SIMS), Fourier Transform infrared spectrscopy(FT-IR), and SEM.