

PROTEIN GRAFTING ONTO CHITOSAN SURFACE USING LOW TEMPERATURE MICROWAVE PLASMA TREATMENT

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Protein chips are useful tools for profiling proteins and analyzing protein-protein interactions and post-translational modifications. To treat the surfaces of polymer and proteins, low temperature plasma treatment is an effective technique^{1,2}. In order to form micro or nano arrays on protein chips, the techniques for patterned modification of substrate surfaces are important. In this study, proteins or chemicals are covalently immobilized on the plasma treated surface of the polysaccharide such as chitosan to produce a high density protein chip. The free amino group of chitosan reacts with an aldehyde to give the corresponding Schiff base. The effects and mechanism of surface modification using low temperature plasma were investigated.

The substrate surface and materials to immobilize are treated by low temperature 2.45 GHz microwave plasma. In the experiments for amino group introduction, NH₃ gas was introduced to plasma reactor after evacuation to $\sim 10^{-3}$ Pa using the turbomolecular pump. The gas flow rate and pressure were generally kept constant at 100 sccm and 13 Pa, respectively. To introduce the other functional groups on the surface, the appropriate gases for plasma production are selected. The chemical composition of plasma treated surface were examined by X-ray photoelectron spectroscopy. The patterned modification are observed by fluorescence microscopy.

XPS spectra of plasma treated surfaces were analyzed. From the C 1s spectra of chitosan, it was found that oxygen bonding with lower energy such hydroxy group (-OH) was partially released. In the case of direct plasma exposure longer than 30 s which ion can reach the surface of chitosan, the peak intensity assigned to -OH group decreased much compared to any other oxygen containing bonding. And nitrogen containing functional groups were increased. The effect of the grafting through the immobilized functional group and patterned modification are performed and discussed.

1. A. Ogino, M. Kral, M. Yamashita, M. Nagatsu, "Effects of Low Temperature Surface-wave Plasma Treatment with Various Gases on Surface Modification of Chitosan", *Appl. Sur. Sci.* 255, 2008, pp.2347-2352.

2. A. Ogino, S. Noguchia, M. Nagatsu, "Effect of Plasma Pretreatment on Heparin Immobilization on Polymer Sheet", *Journal of Photopolymer Science and Technology* 22 No. 4, 2009, pp.461-466.

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