Surface energy change and hydrophilic formation of PE, PS and PTFE films modification by hydrogen ion assisted reaction

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The Polyethylene (PE), Polystyrene (PS) and Polytetrafluoroethylene (PTFE) surface modification was investigated by hydrogen ion assisted reaction (H-IAR) in oxygen environment. The IAR is a kind of surface modification techniques using ion beam irradiation in reactive gas environment. The energy of hydrogen ion beam was fixed at 1 keV, ion dose was varied from 5×10^{14} to 1×10^{17} ions/cm^2, and amount of oxygen blowing gas was fixed 4 ml/min. Wettability was measured by water contact angles measurement, and the surface functionality was analyzed by x-ray photoelectron spectroscopy. The contact angle of water on PE modified by argon ion beam only decrease from $95°$ to $52°$, and surface energy was not changed significantly. But, the contact angle using hydrogen ion beam with flowing 4 ml/min oxygen stiffly decreased to $8°$ and surface energy to 65 ergs/cm. In case of PS, the contact angle and surface energy changes were similar results of PE, but the contact angle of PTFE samples decreased with ion dose up to 1×10^{15} ions/cm^2, increased at higher dose, and finally increased to the extent that no wetting was appeared at 1×10^{17} ions/cm^2.

These results must be due to the hydrogen ion beam that cleans the surface removing the impurities on polymer surfaces, then hydrogen ion beam was activated with C-H bonding to make some functional groups in order to react with the oxygen gases. Finally, unstable polymer surface can be changed from hydrophobic to hydrophilic formation such as C-O and C=O that were confirmed by the XPS analysis, conclusionally, the ion assisted reaction is very effective tools to attach reactive ion species to form functional groups on C-C bond chains of PE, PS and PTFE.