

ORG101

Polymer surface functionalization with micro-flames

Andreas Holländer

Fraunhofer-Institut for Applied Polymer, Potsdam, Germany

andreas.hollaender@iap.fraunhofer.de

In the early days of polymer surface activation flames were used to produce oxidizing gases for increasing the surface free energy and to enable printing and adhesive joining. Soon the flame treatments were replaced by electrical discharge plasmas. Today it is mostly polypropylene and its copolymers, which are treated with flames. For example, PP films are treated with flames on a large industrial scale. But there are other interesting applications of the thermal plasmas, too. One of them we will demonstrate here.

Using capillaries for feeding the burning gas small flames can be produced, which are useful for the locally confined treatment of polymer surfaces. The time required for activation is small and the time of exposure has to be small if the thermal input has to be minimized.

Moving the flame over the surface is one approach to meet this demand.

Pulsing the flame is another one. With a single flame pulse up to 26 at% of oxygen (XPS) can be found at the surface of a polyethylene film. The distribution of the surface oxygen concentration is rather narrow with a FWHM of some mm and a lowest value of 2.8 mm for a 0.5 mm capillary. Pulse repetition rates of 1 pulse per second can be produced easily.

Acetylene, ethene, and butane were used as burning gases in mixture with oxygen. The surface treatment results were very similar for all the gases with respect to the level of oxygen concentration and the distribution of the oxygen concentration at the surface. Of course, all the gases require different gas to oxygen ratios for obtaining optimum treatment results. The oxidation of the surface was found to be rather stable and did not change after storage of two weeks. This is in line with literature results for flame treated polymer surfaces. The flame temperature is highest for acetylene and lowest for butane. The heating of the sample turned out not to be an issue in our investigations. On the other hand, the heating of the surface can be useful for example in the case of treating 3D printed polymer objects. The partial melting results in a smoother surface.

Keywords

activation

flame treatment

structured treatment

polyethylene