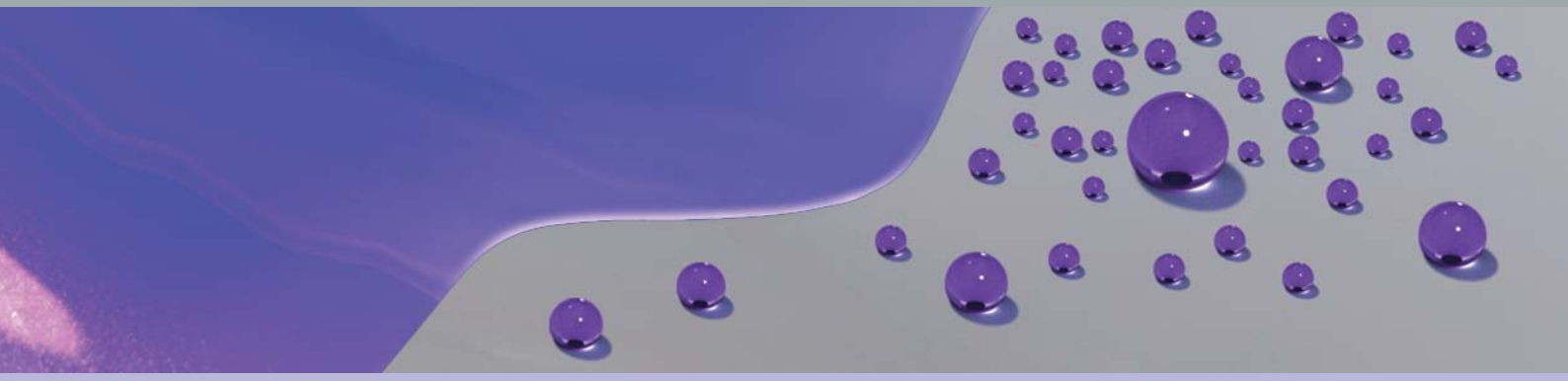
Fraunhofer IWS Dresden

FRAUNHOFER-INSTITUT FÜR WERKSTOFF- UND STRAHLTECHNIK IWS



SURFACE MODIFICATION OF PLASTICS

ATMOSPHERIC PRESSURE PLASMA TECHNOLOGY

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Motivation

Plasma-surface processes are often used to improve the adhesive behavior and the activation of most different surfaces. They are especially firmly established in the field of surface precision cleaning in order to remove residua such as fat and oil. In the case of plastics, the surface modification significantly improves the adhesion of lacquers and very remarkable, the printability as well. These advantages are achieved by generating a new functionality, which mainly bases on the generation of radical sites.

To meet the demands, the Fraunhofer Institute for Material and Beam Technology (IWS) has developed a new plasma technology for large-area depositions under atmospheric pressure.

Solution

The large-area, scalable LARGE plasma source is based on DC arc-ignition at atmospheric pressure. This new technological procedure can be applied to a wide range of surface treatments.

The scientists of the IWS advance different, interdisciplinary approaches of the plasma source development. This concerns the source construction, as well as the electrical and plasma chemical characterization. Finally, the plasma source is tested for surface activation, cleaning and deposition.

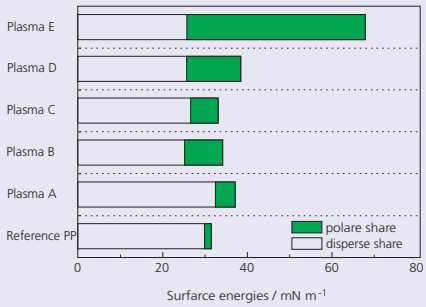
1

2

Results

The polymer treatment comprises four effects: the cleaning, etching and linking the surface-near molecules as well as the modification of the surface structure. In the case of the LARGE plasma source the surface is modified.

Using reactive gas plasma such as oxygen, nitrates and carbon dioxide, the polymer surface (few nm up to 1 µm thick) is purposefully modified. Thus new functionalities emerge, which interact with the material, to be applied, such as lacquers or adhesives. In dependence on the applied plasma and precursor gas we can create defined functional groups such as -C=O, -OH, $-NH_x$, and other. The new chemical and partly topological functionality influences the moistening, polarity and adhesion of the surface.



Surface energies of PP in dependence of plasma gas composites

The IWS scientists apply the LARGE plasma source in a variety of reactors. The coating or etching of surfaces is one example. Furthermore they advance the source into the market in cooperation with other companies.

Offer

To meet the high demands to plasma surface treatments in industrial applications, such as short processing speeds, wide working distances and integration into a processing line, i.e. robot handling, the IWS scientists offer analytical, engineering and diagnostical services:

- fluid dynamical simulation: incident flow of the light arc, reactive gas feeding to the plasma torch,
- equipment design
- plasma diagnostic: Analysis of the reactive species, determination of the plasma species and temperature
- process development: Surface activation, cleaning, deposition
- analytics: Evaluation of the plastics plasma surface treatment

Process parameter of the open plasma test station

Working width:	150 mm, 350 mm
Plasma gases:	Ar, N_2, O_2, H_2, CO_2
Reactive gases / Precursors:	H_2O, CH_4, Ethylacetat ...
Distance:	1 to 7 cm
Proceeding speed:	to 50 m min^{-1}
Substrate:	2D, feasible 3D

1 PP plasma modification with a prefixed IWS mask

2 Tape-test at a masked PP sample