MICROSTRUCTURING POLYMER FILMS BY PLASMA PRINTING

Microstructured surfaces are becoming increasingly important in the field of flexible electronics, displays and even in biomedicine. The demand for systems of this kind is growing constantly. For this reason a new technology has been developed at the Fraunhofer IST by which structured surfaces can be produced rapidly and inexpensively: reel-to-reel plasma printing.

The technique of plasma printing

In plasma printing the structured plasma treatment of the material surface employs a printing process and a suitable mask. The structuring information on the mask is here transferred onto the substrate by microplasmas as area-selective surface modifications. A procedure of this kind permits control in downstream process steps with liquids which behave differently when in contact with the plasma-treated and untreated areas of the surface (cf. Fig. 2).

“Plasma Printing & Packaging Technology P³T”

By following the structured treatment with a wet-chemical metallization, even printed circuits can be produced by plasma printing. This combination of processes is the heart of “Plasma Printing & Packaging Technology”, or P³T for short, developed at the Fraunhofer IST in collaboration with partners from industry and academia.
Plasma printing process
As part of the “P3T” project the plasma printing process has been further developed to the point where continuous coating from reel to reel is possible. This application has already been used successfully for manufacturing RFID antennas and biosensors (cf. Figs. 1 and 2).

The two core components of reel-to-reel plasma printing are a high-voltage electrode, which is sheathed in an isolating material – the so-called dielectric – and as counterelectrode an engraved metallic print roller, as known from conventional rotogravure (cf. Fig. 4).

During plasma treatment the print roller rotates and the polymer film is pressed by the high-voltage electrode against the roller surface. As the film passes over the recesses of the roller structures, gas-filled cavities are created within which the plasma can be ignited (cf. Fig. 5). In this way the print image on the roller can be transferred to the film as an area-selective modification. The process gases are routed into the plasma zone via a gas-nozzle system which is located just before the point where the engraved roller comes into contact with the polymer film. The type of surface functionalization can be selectively controlled via the composition of the process gas.

Applications
Potential areas of application for the plasma printing technology include the manufacturing processes for products such as:
- flexible printed circuits,
- radio frequency identification (RFID) antennas,
- biosensors,
- displays, and
- printed electronics.

Our offer
Production of structured samples – with or without metallization – for application tests at the customer
- Contract research
- Design and development of research systems to customer specifications
- Process development
- Development of production installations in technology transfer
- Licensing

Technical Data

<table>
<thead>
<tr>
<th>Substrate materials used to date</th>
<th>polymer film made of PE, PP, PET, PEN, PI, PEEK</th>
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</thead>
<tbody>
<tr>
<td>Minimum resolution in printing</td>
<td>25 µm</td>
</tr>
<tr>
<td>Throughput speed</td>
<td>tested up to 10 m/min</td>
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<tr>
<td>Width of treatment</td>
<td>tested up to 450 mm</td>
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<tr>
<td>Process gases</td>
<td>dependent on the type of surface modification desired, for example, air, nitrogen, argon, admixtures of other gases (CO₂, N₂, H₂)</td>
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<tr>
<td>Stability</td>
<td>dependent on substrate and plasma parameter, currently &gt;1 year</td>
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</tbody>
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Patents