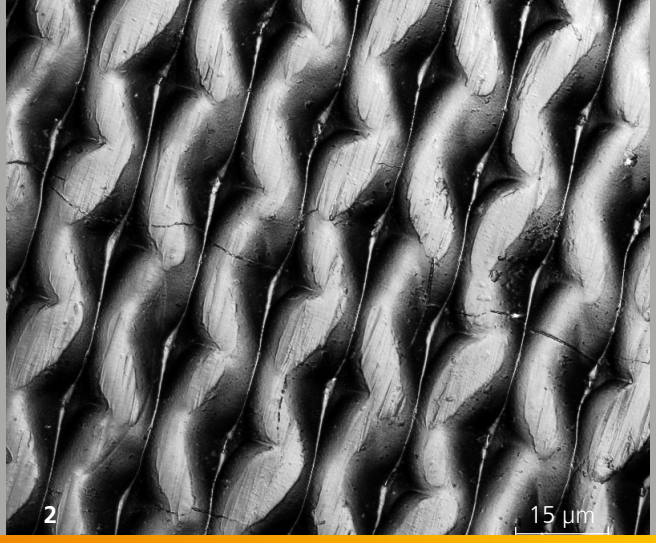
1



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Extract from the annual report 2015
To the website: www.ist.fraunhofer.de/en.html

COMBINATION OF EMBOSSING AND COATING AT ATMOSPHERIC PRESSURE

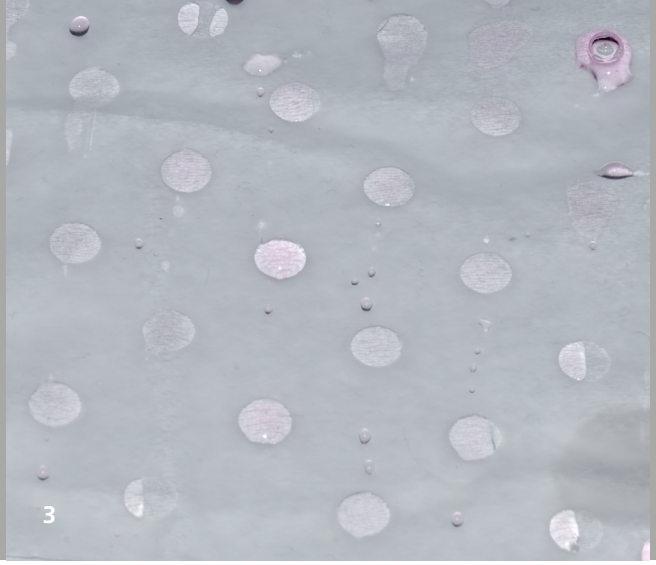
Biofilms often form where proteins adsorb on surfaces. To prevent this, a new combination process for plastic sheeting is under development at the Fraunhofer IST which stops the surface being wetted with solutions containing protein. Here the surface topography of plastic films is modified along the lines of the lotus leaf by the addition of microtexturing transferred by special masks. These inexpensive micro-structured masks are fabricated in collaboration with GRT GmbH & Co KG. In a subsequent step at the Fraunhofer IST a hydrophobic coating is deposited by an atmospheric-pressure plasma process.

Surface treatment

The molding of a defined microstructure onto inexpensive plastic sheeting is carried out using an embossing mask in the form of an engraved metal foil 130 µm thick which is created by high-resolution stylus or laser engraving with defined defined spacing and height parameters (see Fig. 1). By varying the parameters of pressure and temperature the embossing process is set so that the mask structure is entirely transferred to the plastic film without damaging it. In previous attempts the texturing was obtained by depositing weakly bound SiO_x particles with atmospheric pressure plasma. In contrast to surface topographies created by applying an intermediate layer the texturing obtained by embossing the surface of the plastic film (see Fig. 2) has significantly greater mechanical stability.

In the case of the plastic film, the equivalent of the waxy layer given to the lotus leaf by its special structuring is a hydrophobic layer. It is applied by dielectric barrier discharge at atmospheric pressure and is so thin that the contours of the underlying structure are preserved during coating. With hydrophobic coatings of this kind, contact angles of 120° are achieved on smooth substrates. Due to the optimal combination of the microtextured surface and the hydrophobic coating, superhydrophobic surfaces with contact angles greater than 150° are obtained. In this way not only is wetting with water successfully prevented but also with culture media (see Fig. 3).

Fraunhofer Institute for Surface Engineering and Thin Films IST | Bienroder Weg 54 E | 38108 Braunschweig | Germany



Applications

The wetting of plastic surfaces is of crucial importance in a number of fields of application. For example, surfaces with different wetting behaviors are required in medical technology, depending on the application. By giving a suitable structure to the plastic substrate, superhydrophobic or superhydrophilic surface properties can be applied, depending on the coating.

Outlook

One topic for the future is the combination of plastic embossing and atmospheric-pressure plasma processes to create not only flat but also three-dimensional substrates. For this the structuring process will need to be adapted accordingly. It is planned to make these 3D objects from silicone, plastic or epoxy resins by special casting or embossing processes. The complex shapes required here must be provided with the corresponding structures. In a subsequent step the shaped components can then be coated. Coating 3D substrates by means of atmospheric-pressure plasmas has already been successfully demonstrated at the Fraunhofer IST.

1 *Embossing mask for plastic films: metal foil with defined structuring in the area between the spots.*

2 *LSM image of embossed polypropylene film: transfer of a stylus-engraved structure.*

3 *Wetting behavior of embossed and then fully coated polypropylene film; the area around the spots is superhydrophobic.*

CONTACT

Rowena Duckstein
Phone +49 531 2155-619
rowena.duckstein@ist.fraunhofer.de