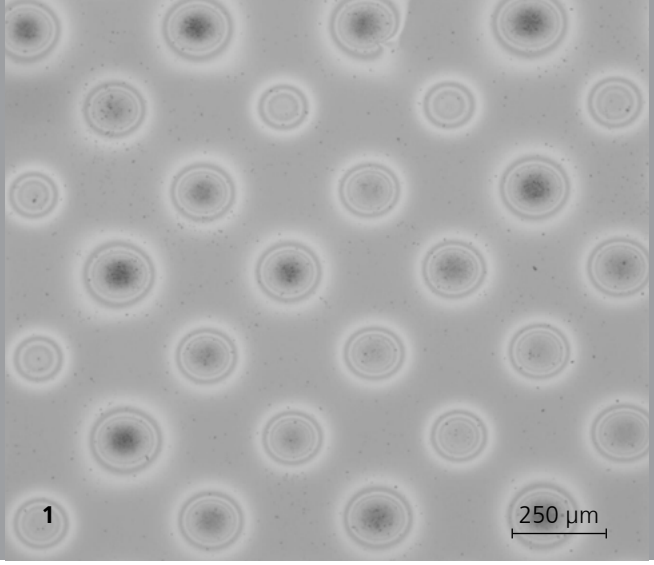
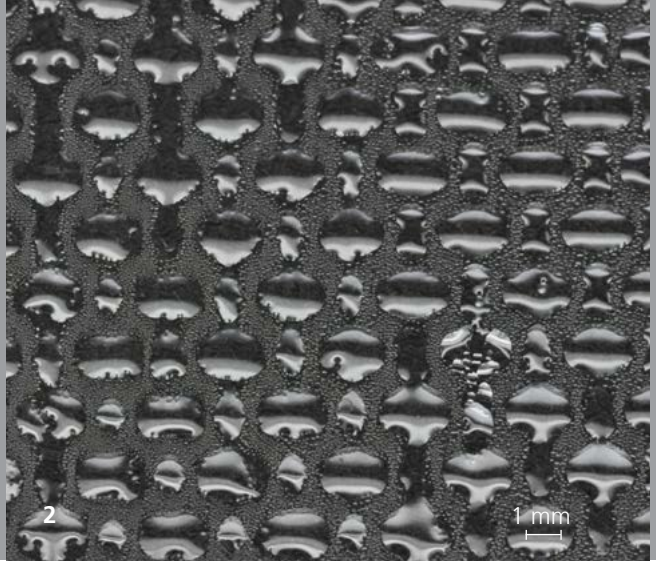




CREATION OF FUNCTIONAL COATING STRUCTURES

In many fields of application, deposited structured coatings have advantages over unstructured coatings. An increase in surface roughness results in a larger surface area, which in turn means that the density of functional groups can be increased and thus too, for example, the docking of biomolecules on a biochip. In addition, a surface topography can influence wetting behavior and thus create effects such as superhydrophilic or superhydrophobic characteristics. Defined dot patterns are, for example, of interest in the biotechnological field for biochip production or for lab-on-a-chip arrangements. One particularly efficient method of depositing functional structured coatings are atmospheric-pressure plasma processes, such as are being developed at the Fraunhofer IST.

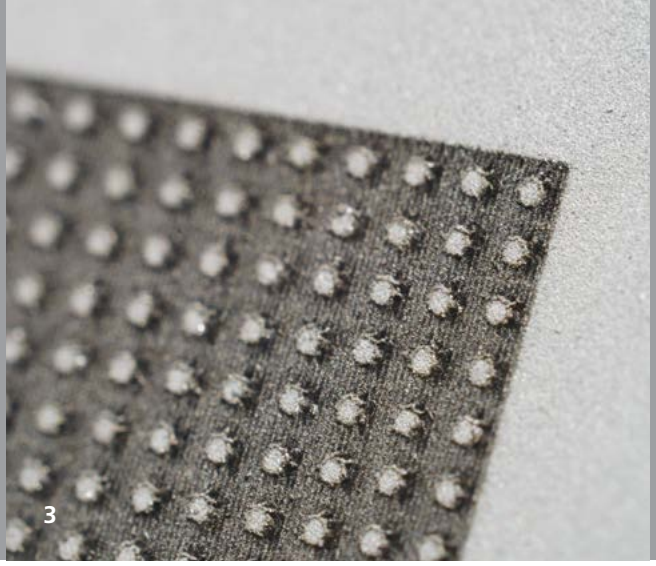
Structuring by means of metal wire meshes and foams

If a sufficiently high AC voltage is applied to two electrodes separated by at least one dielectric material, plasma filaments will form in the gap between the electrodes. The form taken by the filaments is influenced by conductive materials being brought into the plasma area. By using structured conductive materials, such as a metal wire mesh, for example, the discharges will orient themselves to the metal structures in the electrical field. The result is that the coating laid down will reproduce the metallic structure. Regular dot pattern structures can thus be created by using metal wire meshes. The dot patterns may be finer or coarser, depending on the mesh size (Figs. 1 and 2). Open-cell conductive foams can be used for depositing irregular structures with a high degree of surface roughness.

Effects arising from structured coatings

At the Fraunhofer IST fluorescence microscopy has been used to investigate how strong an influence gaining the surface roughness and thereby enlarging the surface area results in an increase of the density of functional groups on the test piece. To do so, structured and unstructured coatings were deposited on glass slides from the precursor gas ethyne. The surfaces were then functionalized with a thin homogeneous layer of aminopropyltrimethoxysilane and the amino groups density determined using fluorescence markers. The structured test piece was three times more fluorescent than its unstructured counterpart which points to a significant increase in the number of amino groups per slide. By depositing markedly particulate and thus very rough silane layers, which were then coated with water-repellent octafluorcyclobutane, it was possible to create superhydrophobic coatings with water contact angles of 162°. By way of comparison, contact angles of only about 120° could be obtained on an unstructured octafluorcyclobutane coating.

© 2014 Fraunhofer IST | https://www.ist.fraunhofer.de
Fraunhofer Institute for Surface Engineering and Thin Films IST | Bienroder Weg 54 E | 38108 Braunschweig | Germany



3

Structuring using a metallically coated dielectric

At the Fraunhofer IST Application Center for Plasma and Photonics in Göttingen, metallic structures were applied at the gap end directly to the dielectric for a controlled generation of filaments. A layer of aluminum about 10 µm thick was deposited on the dielectric by plasma-assisted particle coating synthesis and then structured with a laser (Fig. 3). In the coating process which followed, deposition was greater in the areas of metallic dots. So far it has not been possible to obtain a cleanly demarcated dot pattern structure, such as can be deposited using wire meshes. One promising approach is to use a sputtered and then lasered lattice structure with a coating thickness of only around 100 nm: here it was possible to create stable dot patterns.

Outlook

The aim of further development is to implement precisely configurable structuring even within the dynamic process. In addition, efforts are underway to carry out both structuring and functionalization in a single process step.

1 *Structured coating obtained by deposition using a metal wire mesh.*

2 *Partially hydrophilic coating wetted with water.*

3 *Laser-structured aluminum coating on a glass dielectric.*

CONTACT

Dipl.-Ing.Margret von Hausen
Phone +49 531 2155-622
margret.von.hausen@ist.fraunhofer.de

M. Sc. Thammo Siedenburg
Phone +49 551 3705-338
thammo.siedenburg@ist.fraunhofer.de

© 2014 Fraunhofer IST | https://www.ist.fraunhofer.de
Fraunhofer Institute for Surface Engineering and Thin Films IST | Bienroder Weg 54 E | 38108 Braunschweig | Germany