Press Release

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Laser beams stamp microstructures – Direct Laser Interference Patterning

Professor Mücklich, Professor Lasagni and ten of their colleagues at Saarland University, the Steinbeis-Forschungszentrum Material Engineering Center Saarland, Dresden University of Technology and the Fraunhofer Institute for Material and Beam Technology receive one of two second prizes of the 2016 Berthold Leibinger Innovationspreis.

“Surface functionalization” – a cumbersome term but at the same time a magic word. Two prominent examples of nanopatterned and micropatterned surfaces with functional properties are the water-repellent lotus effect and friction-reducing sharkskin.

Depending upon material and requirements, very different processes are used in the production of functional surfaces. Lasers add a high degree of flexibility. On the one hand, they can penetrate deep into a material by means of targeted heat input, on the other hand, they can also work “cold” through the use of ultrashort pulses. However, the processing times present a great challenge.

A simple calculation demonstrates just how great this challenge is: depending upon thumb size, several 100 millions of structures one micrometer in size have room on a thumbnail. Even if one thousand of these structures could be produced in one second, it would still take more than a day to pattern this small surface.

Thus, broad-scale technical applications would only be imaginable if thousands, millions or even better billions of the tiny structures could be produced at the same time. This would become possible through effects that would allow these structures to generate by themselves or if they could be printed. However, neither option leaves room for flexibility.

At Saarland University, Frank Mücklich used a simple optical effect to combine the flexibility of the laser with areal processing. He thus found

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a compromise between drawn-out, point-by-point construction and inflexible mask technology. So-called interference patterns are created by overlaying two or more laser beams. These patterns can be calculated and the laser beams adjusted accordingly. Periodic micropatterns or nanopatterns are produced on surfaces as large as the beam diameter – that is, in a range of square millimeters or square centimeters. Thus, the combined laser beams can concurrently produce millions to billions of small structures with one “shot”. They are flexible in their settings and can apply structures across large surfaces, just as a stamp transfers a certain pattern.

Together with his working group, Frank Mücklich studies functional materials and has a passion for laser technology. However, he is not satisfied with just publishing his scientific findings and producing samples for laboratories, he also wants the diverse, fascinating abilities of his materials to find a place in everyday life. To achieve this, he founded the Steinbeis-Forschungszentrum Material Engineering Center Saarland in 2009 as a transfer institute for industrial collaborations. Similar to his doctoral advisor Mücklich, Andrés Lasagni at Dresden University of Technology also believes in transferring his technologies to practice. He is specialized in large surface micropatterning and nanopatterning and, together with his team at the Fraunhofer Institute for Material and Beam Technology, has developed a range of systems for different laser interference patterning applications that are ready for industrial use.

Thus the know-how and systems necessary for producing functionalized surfaces are available to users today.

Ideas and requests abound. Next to classic applications such as the minimization of wear on lubricated surfaces, antibacterial properties are also in demand, as are implant surfaces that facilitate cell

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accumulation for improved grafting processes. Improvements in the efficiency of solar cells are planned. Electrical plug-in connections are also to become more reliable in the future, ensuring that loose connections will not have a negative impact on driver assistance systems or autonomous driving features.

In addition to Mücklich und Lasagni, the second prize of the 2016 Berthold Leibinger Innovation Award will go to the following contributors for research and development of both the processes and systems: Dr. Carsten Gachot, Dr. Andreas Rosenkranz, Dr. Michael Hans, Dr. Kim Eric Trinh in Saarbrücken and Dr. Teja Roch, Matthias Bieda, Sebastian Eckhardt, Dr. Denise Günther, Dr. Tim Kunze, Valentin Lang in Dresden.