Materials Research With Ultrashort-Pulse Laser Source

University of Bayreuth uses new LPKF ProtoLaser R4

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Researchers in engineering sciences at the University of Bayreuth now have a unique laser device equipped with an ultrashort-pulse laser source for material processing available to them. In the fields of gas sensor technology, high-frequency technology, and microsystems technology, the device opens up unimagined research possibilities. It can structure layers and coatings on sensitive surfaces with great precision. Hardened or fired technical substrates of all kinds can be precisely cut. The German Research Foundation (DFG) provided 50 percent of the funding for the purchase of the device for the Functional Materials research group.

The laser system is able to generate ultrashort laser pulses that last 1.5 picoseconds – not much longer than a trillionth of a second. As a result, almost no heat transfer occurs during material processing with this laser: the material hit by the laser beam with utmost accuracy evaporates immediately. Consequently, it is all the easier to structure and engrave surfaces at the micrometer level in a controlled manner without damaging adjacent areas. Other examples are the removal of transparent and extremely thin layers from the substrate or the detachment of metal layers from plastic films. Precise cutting and milling of ceramic materials such as aluminum oxide are also possible.

“The new laser processing system is invaluable for the research and development of innovative functional materials, for example, of highly sensitive sensors or extremely finely structured printed circuit boards. On the campus of the University of Bayreuth, it will be accessible to all natural and applied sciences research areas, as well as to external research partners. The device will also enable young scientists to work on research topics for which the necessary infrastructure is lacking at many other university locations,” says Prof. Dr.-Ing. Ralf Moos, Chair of Functional Materials. “We already received a number of inquiries that led to very interesting research work over the last few years with our predecessor system. I am sure that we will receive just as many requests with our new laser

processing system and become involved in exciting new challenges," says Dr.-Ing. Jaroslaw Kita, who supervises the device at Functional Materials.

The laser system is available to researchers for processing a wide range of materials.

The LPKF ProtoLaser R4 was developed especially for use in research on different materials. The system has a 515 nm picosecond laser source with a galvanometer scanner and is standardly equipped with a fiducial alignment camera, an X/Y/Z vacuum table, and the LPKF CircuitPro PL software.

Structuring of layers and coatings is already well tested. With a focus spot size of 15 µm, the beam can structure traces with widths down to 1 mil (25 µm) and spacings down to 15 µm. On thin-film ceramics and on glass, a resolution of 10 µm may even be possible, depending on the metal thickness and the peel strength.

The laser can be used for structuring and engraving a multitude of different materials, including Si, SiN, CoFe, GaN, FR4, Taconic, CuFLON®/PTFE, Al2O3, and LTCC. Engraving with depth control is possible for metals such as copper, nickel, brass, tungsten, and others as well as for plastics such as polyimide/Kapton and many more.

The material processing performed by the ProtoLaser R4 also includes drilling and cutting diverse materials: Borofloat and Schott glass, Si, SiN, CoFe, and GaN; FR4, Rogers, Taconic, Panasonic, CuFlon® / pure PTFE, Al2O3, LTCC, polyimide/Kapton, and other materials used in electrical engineering; and metals such as gold, copper, nickel, platinum, brass, and tungsten.

All of this makes the laser machine an all-round talent for research with a wide range of materials. The Chair of Functional Materials at the University of Bayreuth is already excited about the numerous innovative developments that will be made with his new laser system.

Figures

Fig. 1: Researcher setting up the structuring tasks on the computer Photo by C. Wißler / University of Bayreuth

Fig. 2: Ultrafine structuring of a circuit board Photo by C. Wißler / University of Bayreuth

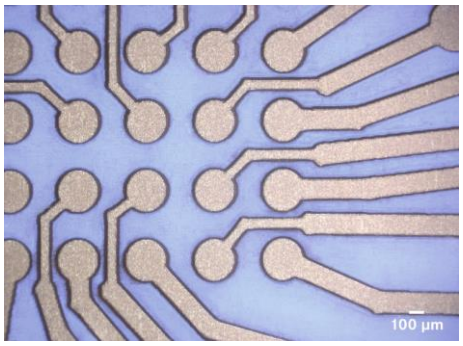

Fig. 3: One application for the ProtoLaser system is structuring of a copper layer on a PET film, as shown here. Photo by LPKF

About LPKF

LPKF Laser & Electronics AG is a leading provider of laser-based solutions for the technology industry. Laser systems from LPKF are key elements in the manufacturing of printed circuit boards, microchips, automotive parts, solar modules, and many other components. Founded in 1976, the company is headquartered in Garbsen, near Hannover, Germany, and has subsidiaries and representative offices throughout the world. Around 20 percent of the workforce is engaged in research and development.

About the Functional Materials Research Group at the University of Bayreuth

The Functional Materials Research Group at the University of Bayreuth was established on July 1, 2001. Prof. Dr.-Ing. Ralf Moos has been the Chair since that time. There are currently more than 20 paid employees plus final-year undergraduates and student assistants employed in the Functional Materials Research Group. Employees from various disciplines work together on numerous projects in the fields of gas sensor technology, exhaust gas aftertreatment, ceramic microsystems technology, and biosensors and materials for energy conversion. The team is made up of engineers specialized in materials science, environmental technology or biotechnology, or electrical engineering, natural scientists specialized in chemistry or applied physics, and laboratory staff. Additional Information: http://www.funktionsmaterialien.de