Editorial

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Laser micro- and nano-material processing – Part 2

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This special issue of *Advanced Optical Technologies* (AOT) is dedicated to the field of laser-based micro- and nano-structuring methods. Due to the unique characteristics of pulsed laser systems, among them ultrafast sources with picosecond and femtosecond pulse durations, today we are experiencing an explosion of new technological developments that will open new perspectives for industrial applications in the near future. This becomes possible due to a continuous reduction in the cost of laser sources as well as the outstanding improvement of the power stability, increased pulse repetition frequencies, as well as the simplicity of the new laser devices.

However, although these developments are necessary for boosting the availability of lasers in modern industrial manufacturing, they alone will not define the industrialization of laser-based applications. In this context, additional efforts are still necessary for understanding how specific surface functionalities on different materials can be created or even improved by developing specific textured surfaces as well as how to produce these topographies at high throughput by the full utilization of the laser performance.

Our list of contributors for this issue reflects a leading-edge mix of experts in these areas, from all around the world. The special issue is published in two parts.

Part 2 of the special issue 'Laser Micro- and Nano-Material Processing' contains four original research articles that are briefly summarized here:

Fosodeder et al. demonstrate in *in-vitro* experiments that a ring of hierarchical micro-nanostructures (self-organized micro-spikes covered with laser-induced periodic surface structures) processed on a titanium alloy cylinder by femtosecond laser irradiation and subsequent anodic oxidation can act as an efficient barrier preventing the overgrowth with fibroblast cells. These results pave way for applications in miniaturized cardiac pacemakers that can be implanted directly into the heart.

Ocaña et al. process hierarchical micro-nanostructures (complex two-dimensional periodic multi-gratings) on plane titanium alloy samples by combining the techniques of nanosecond direct laser writing (DLW) with picosecond direct laser interference patterning (DLIP). The processed surfaces feature a strongly hydrophobic surface wettability and may exhibit an improved electrochemical corrosion resistance.

Genieys et al. study the ablation of four different metals (Al, Cu, Ni, W) irradiated by single titanium sapphire laser pulses with durations ranging between 15 fs and 100 fs. For these metals, a constant ablation threshold is reported and the energy specific ablation efficiency is quantified on the basis of an analysis of the ablation depths. The authors demonstrate that for metals there is no real interest in using few-optical-cycle pulse durations for ablation-based application processes.

Bauerhenne and Garcia analyze the phenomenon of non-thermal melting by performing systematic ab-initio molecular dynamics (MD) simulations of femtosecond laser excited silicon using electron temperature-dependent density functional theory (DFT). The simulations reveal that the indirect electronic band gap decreases as a universal function of the atomic mean-square displacement almost independently of the electronic temperature (laser fluence) and that the dependence is linear for a wide range of mean-square displacements.

We would like to thank all authors for their contributions to this special issue, reporting on new insights in this fascinating topic that significantly increase the capabilities in manufacturing technology. We would also like to acknowledge AOT for coordinating and guiding this special issue as well as all reviewers for their fruitful comments, which permitted improving the quality of the presented articles. We hope you will enjoy reading the articles in this special issue as much as we have enjoyed putting them together.

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Andrés Fabián Lasagni received an MSc degree in Chemical Engineering from National Comahue University, Argentina, in 2002 and a PhD degree in Materials Science from Saarland University, Germany in 2006. From 2007 to 2008, he was a Research Scientist and Alexander von Humboldt Fellow with the Georgia Institute of Technology. From 2008 to 2017, he was a Group Leader with the Fraunhofer Institute for Material and Beam Technology IWS. Since 2012, he is a professor at the Institute of Manufacturing Technology, at the Technische Universität Dresden, and since 2017 is Director of the Center for Advanced Micro-Photonics (CAMP), in cooperation with Frauhnofer IWS. His research interests include the development of functionalized surfaces using laser-based fabrication methods, optical devices for high-throughput laser texturing and recently also in-line monitoring systems. He is the author of more than 250 articles and 30 patents. Prof. Lasagni's awards and honors include the Fritz-Grasenick-Prize (Austrian Society for Electron Microscopy), the Werner Köster Prize (DGM), the German High Tech Champion in Photovoltaic Award (BMBF), the Masing Gedächtnispreis (DGM), the Materials Science and Technology Prize (FEMS) and the Berthold Leibinger Award.

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Jörn Bonse received a Diploma degree in Physics from the University of Hannover, Germany, in 1996, and a Doctoral degree in Physics from the Technical University of Berlin, Germany, in 2001. He has occupied various research positions at institutions such as the Max-Born-Institute for Nonlinear Optics and Short Pulse Spectroscopy (MBI) in Berlin, the Spanish National Research Council (CSIC) in Madrid (Spain), and the Laser Zentrum Hannover (LZH) in Hannover, and was appointed as a Senior Laser Application Specialist at Newport's Spectra-Physics Lasers Division in Stahnsdorf, Germany. Currently, he is a Senior Scientist at the Federal Institute for Materials Research and Testing (BAM) in Berlin, Germany. His research interests include the fundamentals and applications of laser-matter interaction, especially with respect to ultrashort laser pulses, laser-induced periodic nanostructures, time-resolved optical techniques, laser processes in photovoltaics and laser-related safety aspects. In 1999, he was a recipient of an award for applied research, presented by the federal German state of Thuringia, for the development of high-power fiber lasers. Dr. Bonse received a '2013 OSA Outstanding Reviewer Award' of the Optical Society of America (OSA) and served between 2014 and 2017 as an Associate Editor for the OSA journal Optics Express. He has authored more than 130 refereed journal publications and two patents related to his research activities.