



Editorial

Special Issue “Dynamics and Processes at Laser-Irradiated Surfaces—A Themed Issue in Honor of the 70th Birthday of Professor Jürgen Reif”

Florenta Costache ^{1,*} , Stéphane Valette ^{2,*} and Jörn Bonse ^{3,*}

- ¹ Fraunhofer Institute for Photonic Microsystems, IPMS, Maria-Reiche-Str. 2, 01109 Dresden, Germany
² Ecole Centrale de Lyon, LTDS, 36 Avenue Guy de Collongue, 69134 Ecully, France
³ Bundesanstalt für Materialforschung und -prüfung (BAM), Unter den Eichen 87, 12205 Berlin, Germany
* Correspondence: florenta.costache@ipms.fraunhofer.de (F.C.); stephane.valette@ec-lyon.fr (S.V.); joern.bonse@bam.de (J.B.)

The Special Issue “Dynamics and Processes at Laser-irradiated Surfaces” is dedicated to the 70th birthday of Jürgen Reif, retired full professor, former Chair of Experimental Physics II of the Faculty of Physics of the Brandenburg University of Technology Cottbus—Senftenberg in Germany.

This Special Issue was organized by one of his former PhD students and collaborators (F.C.), one of his collaborators (S.V.), and one of his external colleagues (J.B.) in recognition of Jürgen Reif’s long-lasting scientific contributions and research lines in the fields of photonics, semiconductor technology, optical spectroscopy, surface dynamics, in situ measurement techniques, experimental and theoretical investigations of laser–matter interaction, applications of surface functionalization through laser-induced micro- and nanostructures, laser processing of polymers, numerical modeling of surface processes, etc.

Because these scientific areas lie at the boundaries between nonlinear optics and spectroscopy, surface science, solid-state physics, materials science and nanotechnology, and in honor and recognition of Prof. Reif’s scientific contributions, this Special Issue was simultaneously organized in the two journals *Molecules* and *Nanomaterials*, published in a separate branch for each journal [1,2].

For more than 25 years, apart from educating and qualifying university students for the future, the work of Prof. Reif has been very actively devoted to the study of fundamental mechanisms, dynamics, and applications of nano- and micrometer-scale laser-induced periodic surface structures (LIPSS), with a special focus on self-organization processes [3]. His contributions have revived and strongly stimulated the competition of the two main approaches (“schools”) to explain LIPSS, either via matter reorganization or via coherent electromagnetic scattering effects, and investigated their dynamics and applications in the fields of surface wetting and tribology [3,4]. Jürgen Reif and his research group very actively promoted research in the direction of self-organization and made important contributions to this subject [5–8]. During the last few years and with the development and numerical implementation of advanced multi-scale models involving various physical effects, the two LIPSS schools are merging now [4,9,10], while new applications of LIPSS are currently systematically being screened and explored [11–13]. LIPSS represent an important cornerstone for ultrafast laser nanostructuring and the pursuit to extreme scales [14]. This is also reflected by numerous LIPSS-related papers contained in this collection of articles.

Our Special Issue attracted high-quality contributions from both academics and from industry and finally bundles together 1 review paper of Jürgen Reif [3], 1 perspective article [4], and 17 original research articles [15–31]. These publications are focusing on the latest achievements in areas of laser–matter interaction [16,18,22,23,27,30,31], nonlinear optics and photonics [22,23,26], spatial beam shaping [15,28], surface dynamics [4,17,22,23], micro- and nanotechnology [16,18,20,24,26,27,31], laser-induced periodic surface structures



Citation: Costache, F.; Valette, S.; Bonse, J. Special Issue “Dynamics and Processes at Laser-Irradiated Surfaces—A Themed Issue in Honor of the 70th Birthday of Professor Jürgen Reif”. *Nanomaterials* **2023**, *13*, 611. <https://doi.org/10.3390/nano13030611>

Received: 27 January 2023

Accepted: 29 January 2023

Published: 3 February 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

(LIPSS) [3,4,19–21,27,28,31], surface functionalization and applications of laser-textured surfaces [3,4,15,17,21,24,25,27,29,30], and surface wetting and tribology [15,17,25,29]. All of them represent a rewarding dedication to the scientific field and the contributions of Prof. Jürgen Reif, honoring his 70th birthday.

Finally, the Guest Editors would like to express their sincere gratitude to all authors and reviewers of this Special Issue for their contribution to this Special Issue and to the editorial staff of *Nanomaterials* and *Molecules* for their professional support and guidance.

Author Contributions: Conceptualization, F.C., S.V., and J.B.; methodology, F.C., S.V., and J.B.; software, not applicable; validation, F.C., S.V., and J.B.; formal analysis F.C., S.V., and J.B.; investigation, not applicable; resources, not applicable; data curation, not applicable; writing—original draft preparation, J.B.; writing—review and editing, F.C., S.V., and J.B.; visualization, not applicable; supervision, F.C., S.V., and J.B.; project administration, F.C., S.V., and J.B.; funding acquisition, not applicable. All authors have read and agreed to the published version of the manuscript.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The administrative and technical support of Erika Zhao, Olivia Sun, Aimee Liu, and the editorial staff of *Nanomaterials* and *Molecules* is acknowledged here.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Special Issue “Dynamics and Processes at Laser-Irradiated Surfaces—A Themed Issue in Honor of the 70th Birthday of Professor Jürgen Reif”, *Nanomaterials*. Available online: https://www.mdpi.com/journal/nanomaterials/special_issues/Laser-irradiated-Surfaces-Juergen-Reif (accessed on 18 January 2023).
2. Special Issue “Dynamics and Processes at Laser-Irradiated Surfaces—A Themed Issue in Honor of the 70th Birthday of Professor Jürgen Reif”, *Molecules*. Available online: https://www.mdpi.com/journal/molecules/special_issues/juergen_reif (accessed on 18 January 2023).
3. Reif, J. Dynamics and Processes on Laser-Irradiated Surfaces. *Nanomaterials* **2023**, *13*, 379. [CrossRef]
4. Bonse, J.; Gräf, S. Ten Open Questions about Laser-Induced Periodic Surface Structures. *Nanomaterials* **2021**, *11*, 3326. [CrossRef] [PubMed]
5. Reif, J.; Costache, F.; Henyk, M.; Pandelov, S.V. Ripples revisited: Non-classical morphology at the bottom of femtosecond laser ablation craters in transparent dielectrics. *Appl. Surf. Sci.* **2002**, *197*, 891–895. [CrossRef]
6. Costache, F.; Henyk, M.; Reif, J. Modification of dielectric surfaces with ultra-short laser pulses. *Appl. Surf. Sci.* **2002**, *186*, 352. [CrossRef]
7. Costache, F.; Henyk, M.; Reif, J. Surface patterning on insulators upon femtosecond laser ablation. *Appl. Surf. Sci.* **2003**, *486*, 208–209. [CrossRef]
8. Reif, J.; Costache, F.; Bestehorn, M. Self-organized surface nano-structuring by femtosecond laser processing. In *Recent Advances in Laser Processing of Materials*; Perriere, J., Millon, E., Fogarassy, E., Eds.; Elsevier: Amsterdam, The Netherlands, 2006; ISBN 9780080459714.
9. Bonse, J.; Gräf, S. Maxwell Meets Marangoni—A Review of Theories on Laser-Induced Periodic Surface Structures. *Laser Photon. Rev.* **2020**, *14*, 2000215. [CrossRef]
10. Bonse, J. Quo Vadis LIPSS?—Recent and future trends on laser-induced periodic surface structures. *Nanomaterials* **2020**, *10*, 1950. [CrossRef]
11. Gräf, S. Formation of laser-induced periodic surface structures on different materials: Fundamentals, properties and applications. *Adv. Opt. Technol.* **2020**, *9*, 11–39. [CrossRef]
12. Florian, C.; Kirner, S.V.; Krüger, J.; Bonse, J. Surface functionalization by laser-induced periodic surface structures. *J. Laser Appl.* **2020**, *32*, 022063. [CrossRef]
13. Reif, J. Surface Functionalization by Laser-Induced Structuring. In *Advances in the Application of Lasers in Materials Science*; Ossi, P., Ed.; Springer Series in Materials Science; Springer: Cham, Switzerland, 2018; Volume 274. [CrossRef]
14. Stoian, R.; Bonse, J. (Eds.) *Ultrafast Laser Nanostructuring—The Pursuit of Extreme Scales*; Springer Nature: Cham, Switzerland, 2023; (in press). Available online: <https://link.springer.com/book/9783031147517> (accessed on 31 January 2023).
15. Hauschwitz, P.; Bičštová, R.; Brodsky, A.; Kaplan, N.; Cimrman, M.; Huynh, J.; Brajer, J.; Rostohar, D.; Kopeček, J.; Smrž, M.; et al. Towards Rapid Fabrication of Superhydrophobic Surfaces by Multi-Beam Nanostructuring with 40,401 Beams. *Nanomaterials* **2021**, *11*, 1987. [CrossRef]

16. Joy, N.; Kietzig, A.-M. In Situ Collection of Nanoparticles during Femtosecond Laser Machining in Air. *Nanomaterials* **2021**, *11*, 2264. [[CrossRef](#)]
17. Fang, R.; Zhang, X.; Zheng, J.; Pan, Z.; Yang, C.; Deng, L.; Li, R.; Lai, C.; Yan, W.; Maisotsenko, V.S.; et al. Superwicking Functionality of Femtosecond Laser Textured Aluminum at High Temperatures. *Nanomaterials* **2021**, *11*, 2964. [[CrossRef](#)]
18. Hribar, L.; Gregorčič, P.; Senegačnik, M.; Jezeršek, M. The Influence of the Processing Parameters on the Laser-Ablation of Stainless Steel and Brass during the Engraving by Nanosecond Fiber Laser. *Nanomaterials* **2022**, *12*, 232. [[CrossRef](#)] [[PubMed](#)]
19. Bronnikov, K.; Gladkikh, S.; Okotrub, K.; Simanchuk, A.; Zhizhchenko, A.; Kuchmizhak, A.; Dostovalov, A. Regulating Morphology and Composition of Laser-Induced Periodic Structures on Titanium Films with Femtosecond Laser Wavelength and Ambient Environment. *Nanomaterials* **2022**, *12*, 306. [[CrossRef](#)] [[PubMed](#)]
20. Neutsch, K.; Gurevich, E.L.; Hofmann, M.R.; Gerhardt, N.C. Investigation of Laser-Induced Periodic Surface Structures Using Synthetic Optical Holography. *Nanomaterials* **2022**, *12*, 505. [[CrossRef](#)] [[PubMed](#)]
21. Gvozдовskyy, I.; Kazantseva, Z.; Schwarz, S.; Hellmann, R. Influence of Periodic Non-Uniformities of Well-Structured Sapphire Surface by LIPSS on the Alignment of Nematic Liquid Crystal. *Nanomaterials* **2022**, *12*, 508. [[CrossRef](#)] [[PubMed](#)]
22. Zhang, S.; Menoni, C.; Gruzdev, V.; Chowdhury, E. Ultrafast Laser Material Damage Simulation—A New Look at an Old Problem. *Nanomaterials* **2022**, *12*, 1259. [[CrossRef](#)]
23. Uehlein, M.; Weber, S.T.; Rethfeld, B. Influence of Electronic Non-Equilibrium on Energy Distribution and Dissipation in Aluminum Studied with an Extended Two-Temperature Model. *Nanomaterials* **2022**, *12*, 1655. [[CrossRef](#)]
24. Koromyslov, S.; Ageev, E.; Ponkratova, E.; Larin, A.; Shishkin, I.; Danilov, D.; Mukhin, I.; Makarov, S.; Zuev, D. Femtosecond Laser-Assisted Formation of Hybrid Nanoparticles from Bi-Layer Gold–Silicon Films for Microscale White-Light Source. *Nanomaterials* **2022**, *12*, 1756. [[CrossRef](#)]
25. Wang, S.; Du, B.; Xing, B.; Hong, Y.; Wang, Y.; Du, B.; Zheng, Y.; Ye, J.; Li, C. Interface Adhesion Property and Laser Ablation Performance of GAP-PET Double-Layer Tape with Plasma Treatment. *Nanomaterials* **2022**, *12*, 1827. [[CrossRef](#)]
26. Byram, C.; Rathod, J.; Moram, S.S.B.; Mangababu, A.; Soma, V.R. Picosecond Laser-Ablated Nanoparticles Loaded Filter Paper for SERS-Based Trace Detection of Thiram, 1,3,5-Trinitroperhydro-1,3,5-triazine (RDX), and Nile Blue. *Nanomaterials* **2022**, *12*, 2150. [[CrossRef](#)] [[PubMed](#)]
27. Porta-Velilla, L.; Turan, N.; Cubero, Á.; Shao, W.; Li, H.; de la Fuente, G.F.; Martínez, E.; Larrea, Á.; Castro, M.; Koralay, H.; et al. Highly Regular Hexagonally-Arranged Nanostructures on Ni-W Alloy Tapes upon Irradiation with Ultrashort UV Laser Pulses. *Nanomaterials* **2022**, *12*, 2380. [[CrossRef](#)]
28. Schille, J.; Chirinos, J.R.; Mao, X.; Schneider, L.; Horn, M.; Loeschner, U.; Zorba, V. Formation of Nano- and Micro-Scale Surface Features Induced by Long-Range Femtosecond Filament Laser Ablation. *Nanomaterials* **2022**, *12*, 2493. [[CrossRef](#)] [[PubMed](#)]
29. Basset, S.; Heisbourg, G.; Pascale-Hamri, A.; Benayoun, S.; Valette, S. Effect of Texturing Environment on Wetting of Biomimetic Superhydrophobic Surfaces Designed by Femtosecond Laser Texturing. *Nanomaterials* **2022**, *12*, 3099. [[CrossRef](#)]
30. Canguero, L.; Ramos-de-Campos, J.A.; Bruneel, D. Prediction of Thermal Damage upon Ultrafast Laser Ablation of Metals. *Molecules* **2021**, *26*, 6327. [[CrossRef](#)]
31. Maragkaki, S.; Lingos, P.C.; Tsibidis, G.D.; Deligeorgis, G.; Stratakis, E. Impact of Pre-Patterned Structures on Features of Laser-Induced Periodic Surface Structures. *Molecules* **2021**, *26*, 7330. [[CrossRef](#)] [[PubMed](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.