Editorial

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“Light Confinement and Control with Structured Dielectrics and Metals” is the title of the Research Unit 557, granted by the Deutsche Forschungsgemeinschaft (DFG). During two funding periods, lasting a total of more than six years, researchers from the University of Bonn, as well as from the Universities Mainz, Stuttgart and Wuppertal explored new light-matter interaction schemes. Although dielectrics and metals have been used for centuries in order to manipulate light, e.g., in the form of glass lenses and silver mirrors, the full potential of this approach is far from being reached. Tailored and optimized dielectric bulk materials as well as micro- and nanostructured dielectrics and metals help to get closer to physical limits of light confinement and control set by Maxwell’s equations and quantum physics.

Featuring eleven review articles, this special issue of “Applied Physics B: Lasers and Optics” reports about the achievements we have obtained in the framework of the projects of the second funding period. Following the spirit of the Research Unit, the topics span a wide range: Some projects were dedicated to material physics and new methods to shape volume or surface structures. Here, thin molecular layers and metal films, meta-materials as well as nonlinear-optical bulk crystals were studied in depth and their optical properties were characterized, e.g., with advanced nonlinear spectroscopy. Moreover, several applications were realized, such as, e.g., new bottle fiber resonators for quantum optics, tapered optical fibers for sensors, whispering-gallery-mode resonators for frequency

conversion and periodically poled crystals for novel light sources, as well as enhanced light-matter interaction leading to Bose–Einstein condensation of photons. Several of the projects benefited from the close interaction between experiment and theory with the Research Unit.

In addition to highlighting just work performed within the Research Unit, we also intended to summarize, to the best of our knowledge, the state of the art with regard to other fields of advanced light confinement and control. Although the scientific progress in this domain, driven by many dedicated colleagues all around the world as well as by the Research Unit 557, is really impressive, it became clear that also the next decade will be full of discoveries in this research field – we have by far not yet reached the limits where individual photons can be easily controlled, directed, and processed and where switching occurs at the speed of a single light cycle, just to name some examples. Thus, this field became even more agile and demanding than it has been at the time the Research Unit was established.

We are thankful to the Deutsche Forschungsgemeinschaft, which enabled this kind of close collaboration. We also thank the University of Bonn, which made this Research Unit possible by supplying special starting funds and by administrative support. We are in particular thankful to the many colleagues – their number exceeds one hundred – who visited us in Bonn in order to share and to discuss results, either for short visits and colloquium talks or for longer research stays. Many of these collaborations, started or intensified by Research Unit 557, will be continued in the future. Finally, we are also thankful to the reviewers of our Research Unit, who provided valuable hints and suggestions and thereby contributed to the very satisfying evolution of this coordinated research activity.

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Sincerely,
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