Editorial

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Green photonics: sustainable solutions for a future with light

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Mankind faces a multitude of global challenges. The growth in global population and the rise of developing and newly industrialized countries will exacerbate demand for food, water and energy in the years ahead. Global demand for natural resources, and especially for the source materials required to safeguard industrial production, has reached record levels in recent years and will continue to grow if it is to meet the needs of the world's population. The limits of growth, a consequence of the finite existence of fossil fuels and raw materials, of climate change and environmental pollution, can already be observed in many areas. We will be forced to make changes and develop solutions to secure the foundations of human existence on our planet.

'Green photonics' – the sustainable use of light – can make a valuable contribution to solving these future issues:

- *Light* is the basis of carbon-neutral energy conversion
- *Light* enables processes which make efficient use of energy and resources
- *Light* helps to manage environmental and climate disasters
- *Light* contributes to safe food and drinking water supplies

There is no doubt that photovoltaics and thermophotovoltaics, together with artificial photosynthesis, will play a major part in the energy supply of the future. Converting just a small fraction of the sunlight which reaches the Earth into electrical energy can solve the core energy technology challenges the world currently faces – microstructures and nanostructures for active photon management in solar cells will help to further increase the efficiency of the devices. Another key example of research in the field of green photonics is the development of energy efficient lighting technology. At present, almost 20% of the electrical energy produced in the world is used for lighting purposes, but making changes such as adopting the use of modern LED technology could save more than 50% of this energy, amounting to a CO_2 equivalent of 600 million tons. In other areas, the targeted use of light can also help to monitor important atmospheric trace gases which drive the green house effect or play an important role for the oxidative capacity of the atmosphere. Lasers as a tool make a 'green switch' possible for the machining industry as an enabler of energy and resource efficient production processes—they facilitate the optimization of technical products, a prominent example is the reduction of friction in lubricated contact laser-based hole drilling for injection valves. This technology helps to optimize gasoline consumption, optimize plant growth or sterilize drinking water. The sustainable use of light will therefore be a leading scientific concern in the 21st century.

This special issue presents current research in the field of green photonics aimed at solving pressing future challenges.

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Andreas Tünnermann received his diploma and PhD degrees in Physics from the University of Hannover in 1988 and 1992, respectively. In 1997, he received the habilitation. He was the head of the Department of Development at the Laser Zentrum Hannover from 1992 to 1997. In the beginning of 1998, he joined the Friedrich-Schiller University in Jena, Germany, as a Professor and Director of the Institute of Applied Physics. In 2003, he was appointed as the

Director of the Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena. His main research interests include scientific and technical aspects associated with the tailoring of light. Andreas Tünnermann is author of more than 400 papers in renowned international journals. He is a sought-after expert in the optics and photonics industry. He is the founder and a member of the board of directors of the industry-driven cluster OptoNet Jena, one of the most dynamic regional optic clusters in Europe. His research activities on applied quantum electronics have been awarded, e.g., with the Gottfried-Wilhelm-Leibniz-Award (2005). He is a fellow of SPIE and OSA.

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Kimio Tatsuno joined Hitachi Ltd., CRL Kokubunji, Tokyo in 1973 after receiving his Master's degree in Applied Physics from the University of Osaka. He started his research on a 'holographic memory' followed by the R&D for the laser diode system applications such as 'optical disc', 'diode laser interferometer', 'laser beam printer', 'SHG laser' and 'transceiver modules for optical fiber communications. He stayed at the Philips Nat. Lab., Eindhoven from 1986 to 1987 as an exchange researcher.

From 2003 to 2007, Hitachi sent him to NISTEP (National Institute of Science and Technology Policy) as a unit leader for a strategic research in the field of Information and Communication Technology, and from 2007 to 2012 to OITDA (Optical Industry and Technology Development Association) to research industrial strategies for the photonic industry and academia. After leaving Hitachi in 2012, he is now serving for Koga Research Institute (KRI) Inc., in Tokyo.

He has published more than 30 papers, 50 patents and co-authored several books in the field of Optics and Photonics. He was a part time lecturer for the Tokyo Metropolitan University from 2001 to 2008 and Tsukuba University 2012 to 2014. He is a member of JSAP, OSJ and EOS. He was a Vice President of the OSJ and has organized the bi-annual international conference ODF (Optics-photonics Design and Fabrication) since 1998 and has been serving the EOS as an Asia Liaison officer since 2012.