

# Optical Engineering

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## **Laser Damage**

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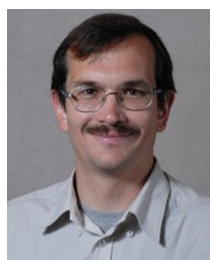
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Laser damage of optical materials, first reported in 1964, continues to limit the output energy and power of pulsed and continuous-wave laser systems. In spite of some 48 years of research in this area, interest from the international laser community to laser damage issues remains at a very high level and does not show any sign of decreasing. Moreover, it grows with the development of novel laser systems, for example, ultrafast and short-wavelength lasers that involve new damage effects and specific mechanisms not studied before. This interest is evident from the high level of attendance and presentations at the annual SPIE Laser Damage Symposium (aka, Boulder Damage Symposium) that has been held in Boulder, Colorado, since 1969. This special section of *Optical Engineering* is the first one devoted to the entire field of laser damage rather than to a specific part. It is prepared in response to growing interest from the international laser-damage community. Some papers in this special section were presented at the Laser Damage Symposium; others were submitted in response to the general call for papers for this special section.

The 18 papers compiled into this special section represent many sides of the broad field of laser-damage research. They consider theoretical studies of the fundamental mechanisms of laser damage including laser-driven electron dynamics in solids (O. Brenk and B. Rethfeld; A. Nikiforov, A. Epifanov, and S. Garnov; T. Apostolova et al.), modeling of propagation effects for ultrashort high-intensity laser pulses (J. Gulley), an overview of mechanisms of inclusion-induced damage (M. Koldunov and A. Manenkov), the formation of specific periodic ripples on a metal surface by femtosecond laser pulses (M. Ahsan and M. Lee), and the laser-plasma effects on damage in glass (Y. Li et al). Material characterization is represented by the papers devoted to accurate and reliable measurements of absorption with special emphasis on thin films (C. Mühlig and S. Bublitz; B. Cho, E. Danielewicz, and J. Rudisill; W. Palm et al; and J. Lu et al.). Statistical treatment of measurements of the laser-damage threshold (J. Arenberg) and the relationship to damage mechanisms (F. Wagner et al.) represent the large subfield of laser-damage measurements. Various aspects of multilayer coating and thin-film characterization are considered in papers by B. Cho, J. Rudisill, and E. Danielewicz (spectral shift in multilayer mirrors) and R. Weber et al. (novel approach to damage studies based on third-harmonic generation microscopy). Of

special interest for readers is the paper by C. Stolz that summarizes the results of four "thin-film damage competitions" organized as a part of the Laser Damage Symposium. Another paper is devoted to thermal annealing of damage precursors (N. Shen et al.). Finally, the influence of nano-size contamination on initiation of laser damage by ultrashort pulses is considered in paper of V. Komolov et al.

The emerging research developments in the field of laser damage and optical materials for high-power lasers represented by these papers will be very beneficial for readers of *Optical Engineering* and researchers from closely related areas.



**Vitaly E. Gruzdev** received an MS in optical systems and devices from the Institute of Fine Mechanics and Optics in St. Petersburg, Russia, in 1994, and a PhD from S. I. Vavilov State Optical Institute in St. Petersburg, Russia, in 2000 in the field of optics. He worked in the Laboratory of Surface Photo-physics lead by Dr. M. Libenson and later in the laboratory of Academician of Russian Academy of Sciences Dr. A. M. Bonch-Bruевич at the State Optical Institute. He was a visiting researcher at the group of Prof. Dr. D. von der Linde from 2001 to 2003. In 2005 he joined the Center for Ultrafast Ultra-intense Lasers of the College of Engineering, University of Missouri. Currently, he is a research assistant professor with the Department of Mechanical and Aerospace Engineering of the University of Missouri. Since 2009, he is a co-chair of the SPIE Laser Damage Symposium.



**Michelle Shinn** chief optical scientist of the FEL Division, has been at Jefferson Lab since 1995. From 1996 to 1999, she led the design, procurement, and installation activities for the IR Demo free electron laser (FEL) optical cavity, transport and diagnostics, and from 1999 to 2006 she performed the same duties on the Upgrade FEL, the world's highest power tunable ultrafast laser. In her capacity as chief optical scientist she sets the specifications of the FEL optical systems and analyzes their performance. She actively collaborates with a number of teams that use the FEL, and in particular, pursues her own research on the characterization of dielectric thin films for laser applications, and laser-induced damage of optical components. Before coming to Jefferson Lab, she was a physicist in the Laser Division at Lawrence Livermore National Lab (1984–1990), and associate professor of physics at Bryn Mawr College (1990–1995).