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## LLE Review Quarterly Report



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## **In Brief**

This volume of the LLE Review, covering July–September 2010, features "Grating Inspection System for Large-Scale Multilayer-Dielectric Gratings for High-Energy Laser Systems" by T. Nguyen, C. Kingsley, J. Bunkenburg, A. Kalb, M. Bedzyk, D. Weiner, T. Walker, and J. R. Marciante. The article (p. 165) reports on the development of a high-resolution inspection system for the detection of laser damage on large-scale (1.41-m  $\times$  0.43-m) multilayer diffraction gratings in the OMEGA EP short-pulse laser system. The grating inspection system (GIS) is fully integrated within the vacuum grating compressor and enables inspections to be carried out while the compressor chamber is under vacuum. Damage is detected by imaging scattered light from damage sites on the grating surface. Features as small as 250  $\mu$ m can be identified with the system.

Additional highlights of research presented in this issue include the following:

- P. M. Nilson, A. A. Solodov, J. F. Myatt, W. Theobald, P. A. Jaanimagi, L. Gao, C. Stoeckl, R. S. Craxton, J. A. Delettrez, J. D. Zuegel, B. E. Kruschwitz, C. Dorrer, J. H. Kelly, R. Betti, T. C. Sangster, and D. D. Meyerhofer (LLE); K. U. Akli (General Atomics); and P. K. Patel and A. MacKinnon (LLNL) report on the scaling of hot-electron generation to high-power, kilojoule-class laser–solid interactions (p. 174). Thin-foil targets were irradiated with high-power (1- to 210-TW), 10-ps pulses focused to intensities of  $I > 10^{18}$  W/cm<sup>2</sup> and studied with K-photon spectroscopy. Comparing the energy emitted in K photons to target-heating calculations shows a laser-energy-coupling efficiency to hot electrons of  $\eta_{L\rightarrow e} = 20 \pm 10\%$ . Time-resolved x-ray–emission measurements suggest that laser energy is coupled to hot electrons over the entire duration of the incident laser drive. Comparison of the K-photon emission data to previous data at similar laser intensities shows that  $\eta_{L\rightarrow e}$  is independent of laser-pulse duration from 1 ps  $\leq \tau_p \leq 10$  ps.
- W. R. Donaldson, J. H. Kelly, and R. E. Bahr (LLE); and D. N. Maywar (Rochester Institute of Technology) present a measurement of the self-phase modulation-induced bandwidth in a 30-kJ-class laser-amplifier chain (p. 179). Self-phase modulation (SPM) in a multikilojoule laser system was detected spectroscopically and correlated with the time derivative of the intensity measured at the output of the system. This correlation provides an empirical relationship that makes it possible to rapidly determine the magnitude of the SPM being generated using measured experimental data. This empirical relationship was verified by modeling the propagation of an optical pulse in the laser amplifier chain to predict both pulse shape and the SPM.
- J. B. Oliver, P. Kupinski, A. L. Rigatti, A. W. Schmid, J. C. Lambropoulos, S. Papernov, A. Kozlov, J. Spaulding, D. Sadowski, Z. Chrzan, and R. D. Hand (LLE); D. R. Gibson and I. Brinkley (Thin Film Solution, Ltd., Scotland); and F. Placido (University of West Scotland, Scotland) describe large-aperture plasma-assisted deposition of ICF laser coatings (p. 184). Plasma-assisted electron-beam evaporation leads to changes in the crystallinity, density, and stresses of thin films. A dual-source plasma system was developed that provides stress control of large-aperture, high-fluence coatings used in vacuum for substrates 1 m in aperture.

- B. E. Kruschwitz, S.-W. Bahk, J. Bromage, D. Irwin, and M. D. Moore present an improved on-shot focal-spot measurement on OMEGA EP using phase-retrieval–enhanced wavefront measurements (p. 192). Target-plane intensities on the short-pulse beamlines of OMEGA EP are characterized on-shot using the focal-spot diagnostic (FSD), an indirect wavefront-based measurement. Phase-retrieval methods are employed using on-shot and off-line far-field measurements to improve the on-shot wavefront measurements and yield more-accurate, repeatable focal-spot predictions. Incorporation of these techniques has resulted in consistently high (>90%) correlation between the FSD focal-spot predictions and direct far-field fluence measurements in the target chamber in low-energy testing.
- R. D. Petrasso (Plasma Science and Fusion Center, MIT) reports on the second Omega Laser Facility
  Users Group Workshop (28–30 April 2010) on p. 205. LLE hosted more than 115 researchers from
  44 universities and laboratories and 9 countries for the second Omega Laser Facility Users Group
  (OLUG) workshop. The workshop fostered communications among the individual OMEGA users
  and between users and the facility, including discussions of research results and opportunities and
  improvements in the Omega and Omega EP laser facilities. An important function of the workshop
  was to develop a set of recommendations and findings to help set future priorities for the Omega
  Laser Facility.
- This volume concludes with a summary of LLE's Summer High School Research Program (p. 224), the FY10 Laser Facility Report (p. 226), and the National Laser Users' Facility and External Users' Programs (p. 229).

Brian E. Kruschwitz *Editor*