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LLE Review

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Contents

In Brief

This volume of the LLE Review, covering January–March 2008, features "Cryogenic Targets: Current Status and Future Development," by D. R. Harding, D. H. Edgell, M. D. Wittman, L. M. Elasky, S. J. Verbridge, A. J. Weaver, L. D. Lund, W. Seka, W. T. Shmayda, R. T. Janezic, M. J. Shoup III, M. Moore, R. Junquist, and A. V. Okishev. In this article (p. 57), the authors report on the status of layering cryogenic DT and D_2 targets at LLE for inertial confinement fusion (ICF) targets. This critical effort achieves the important milestone of routinely providing cryogenic DT targets that meet the 1.0-μm (rms) OMEGA ice-quality-surface specification. The best D_2-ice layers produced so far (rms roughness of 1.1 μm) are approaching the quality typically achieved in DT targets. Efforts to improve the consistency of this process are reported along with investigations supporting the National Ignition Campaign studying issues relevant to indirect-drive and direct-drive cryogenic targets.

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

- J. A. Marozas, T. J. B. Collins, and J. D. Zuegel present an improved laser speckle smoothing scheme that augments the current NIF 1-D SSD system by using multiple-FM modulators (MultiFM 1-D SSD) (p. 73). With a judicious choice of modulator frequencies, MultiFM 1-D SSD smoothes resonances produced at the higher spatial frequencies and can attain similar or even faster smoothing rates compared to the baseline NIF 2-D SSD system. *DRACO* simulations have shown that MultiFM 1-D SSD beam smoothing is sufficient for the direct-drive-ignition targets and pulse shapes analyzed thus far, and may even allow reducing the bandwidth enough to eliminate the need for dual-tripler frequency conversion on the NIF.

- C. K. Li, F. H. Séguin, J. R. Rygg, J. A. Frenje, M. Manuel, and R. D. Petrasso (Plasma Science Fusion Center, MIT), along with R. Betti, J. A. Delettrez, J. P. Knauer, F. J. Marshall, D. D. Meyerhofer, V. A. Smalyuk, and C. Stoeckl (LLE), D. Shvarts (Nuclear Research Center Negev), O. L. Landen and R. P. J. Town (LLNL), and C. A. Back and J. D. Kilkenny (General Atomics) describe time-gated, monoenergetic proton radiography that provides unique measurements of implosion dynamics of spherical targets in direct-drive inertial confinement fusion (ICF) (p. 81). Radiographs obtained at different implosion times, from acceleration, through coasting, deceleration, to final stagnation, display a comprehensive picture of spherical ICF implosion. Critical information inferred from such images characterizes the spatial structure and temporal evolution of self-generated fields and plasma areal density.

- C. Dorrer, J. Bromage, and J. D. Zuegel describe a single-shot cross-correlator based on a pulse replicator that produces a discrete sequence of sampling pulses that are nonlinearly mixed with the pulse under test (p. 86). The combination of a high reflector and partial reflector replicates an optical pulse by multiple internal reflections and generates a sequence of spatially displaced and temporally delayed sampling pulses. This principle is used in a cross-correlator characterizing optical pulses at 1053 nm, where a dynamic range higher than 60 dB is obtained over a temporal range larger than 200 ps. The dynamic range can be extended with standard optical-density filters and the temporal range extended with larger optics.

- S.-W. Bahk, J. Bromage, I. A. Begishev, C. Mileham, C. Stoeckl, M. Storm, and J. D. Zuegel present a novel focal-spot diagnostic developed for OMEGA EP that will be used to characterize on-shot focal spots to support high-quality laser–matter interaction experiments (p. 94). The complex fields in the region of the high-energy focus are calculated using high-resolution measurements of the main beam wavefront using the focal-spot diagnostic (FSD) located on the short-pulse diagnostic package and a careful calibration of the transfer wavefront between the FSD instrument and target chamber center. The concept of this calibration procedure is experimentally verified in the Multi-Terawatt (MTW) Laser System, which serves as a development platform for OMEGA EP. A technique based on phase retrieval is employed for the transfer-wavefront calibration since the OMEGA EP infrastructure cannot be replicated in the MTW laser; however, this approach also shows promise as an alternative method for OMEGA EP.

- J. B. Oliver, S. Papernov, A. W. Schmid, and J. C. Lambropoulos report on a systematic study to improve the laser-damage resistance of multilayer high-reflector coatings for use at 351 nm on the OMEGA EP Laser System (p. 103). A series of hafnium dioxide monolayer films deposited by electron-beam evaporation with varying deposition rates and oxygen backfill pressures were studied using transmission electron microscopy (TEM), x-ray diffraction (XRD), and refractive index modeling. These exhibit microstructural changes for sufficiently slow deposition rates and high oxygen backfill pressures, resulting in an absence of crystalline inclusions and a lower refractive index. This process was used to fabricate reduced-electric-field-type multilayer, high-reflector coatings that achieved laser-damage thresholds as high as 16.6 J/cm^2, which represents exceptional improvement over previous damage thresholds measured at this wavelength of the order of 3 to 5 J/cm^2.

Jonathan Zuegel
Editor