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LLE Review

Quarterly Report

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Contents

In Brief

This volume of the LLE Review, covering October–December 2001, features "Time-Integrated Light Images of OMEGA Implosions" by P. Morley and W. Seka (p. 1). E. Kowaluk initiated this project for aesthetic rather than scientific reasons when he began taking visible light photographs of imploding OMEGA targets. These beautiful images are used to communicate LLE's mission to the general public. A closer examination of the images revealed a one-to-one correspondence between the bright spots in the image and each of the 60 laser beams. The intensity of the bright spots has been related to refraction and absorption in the plasma surrounding the imploding target. These photographs are now proving to be the basis of a new laser–plasma interaction diagnostic.

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

- V. N. Goncharov (p. 6) presents an analytical model of the nonlinear bubble evolution of single-mode, classical Rayleigh–Taylor (RT) instability at arbitrary Atwood numbers. The model follows the continuous evolution of bubbles from the early exponential growth to the nonlinear regime when the bubble velocity saturates.

- J. A. Marozas (p. 11) demonstrates a reduced-autocorrelation phase plate design for OMEGA and the National Ignition Facility (NIF). Direct-drive inertial confinement fusion (ICF) for the NIF requires that the time-averaged rms laser nonuniformity be below the 1% level. The lower spatial frequencies of the laser nonuniformity are dangerous to the hydrodynamic stability of the ICF target. A reduced autocorrelation phase design shifts the speckle energy up into the higher spatial frequencies where smoothing by spectral dispersion (SSD) and thermal smoothing in the target corona are most efficient. A novel design method for calculating a reduced correlation phase plate is presented, and the smoothing performance results are compared to a standard phase plate.

- W. Shmayda (p. 25) describes LLE's Tritium Recovery System, which is used to clean up the various exhaust streams and to control tritium activity in the gloveboxes. This system is optimized for minimum environmental impact and maximum personnel safety. It uses the best-available technologies to extract tritium from inert gas streams in the elemental form. The rationale for the selection of various technologies is discussed in detail. This approach reduces the volumes of effluent that require treatment to the extent practical and also avoids the need to oxidize HT to HTO with its higher radiotoxicity, thereby contributing to safety.

- S. Papernov and A. W. Schmid (p. 30) use a SiO_2-thin-film system with absorbing gold nanoparticles to study the connection between the pulsed-laser energy absorption process and film damage morphology. They show that, at low laser fluences (below the threshold where damage can be detected optically), the probability of crater formation and the amount of the material vaporized are almost independent of the particle size. Inhomogeneities in the particle environment are responsible for variances in the observed particle/damage crater correlation behavior. In the proposed damage mechanism the initial absorption is confined to the nanoscale defect. Energy absorbed by the defect quickly heats the surrounding matrix, changing it from a transparent to an absorbing media, which creates a positive-feedback mechanism that leads to crater formation.

- G. Sabouret, C. Williams, and R. Sobolewski (p. 40) report on the time-resolved dynamics of the superconducting-to-resistive transition in dc-biased epitaxial $YBa_2Cu_3O_{7-x}$ (YBCO) microbridges, excited by nanosecond-long current pulses. The resistive switching was induced by the collaborative effect of both the Cooper-pair bias current and the quasiparticle pulse excitation, which together always exceeded the bridge critical current, forming the supercritical perturbation. The experimental dynamics was analyzed using the Geier and Schön (GS) theory, which was modified to include the dc bias. The resistive state was established after a delay time t_d, in agreement with the GS model, which depended in a nonlinear way on both the excitation pulse magnitude and the bridge dc bias.

- W. T. Shmayda (LLE) and S. Zukotynski, D. Yeghikyan, and F. Gaspari from the Department of Electrical Engineering and Computer Engineering at the University of Toronto describe (p. 44) a series of thin, hydrogenated amorphous carbon films that have been deposited using the saddle-field deposition configuration. These films are a precursor to depositing tritiated films. Smooth, low-porosity films up to 15 μm thick and with densities up to 2 g/cc have been grown. The internal structure of the films is featureless. Operating pressure plays an important role in modulating the film quality, growth rate, and density. Eliminating the substrate bias reduces negative ion incorporation in the films to help increase film density and improve film quality.

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