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Contents

In Brief

This volume of the LLE Review, covering January–April 2003, features "Optimization of Deposition Uniformity for Large-Aperture NIF Substrates in a Planetary Rotation System" by J. B. Oliver and D. Talbot (p. 67). For the National Ignition Facility (NIF), coating thickness nonuniformity must not exceed 0.5% peak-to-valley over a 0.85-m aperture. This article describes the design and performance of a thin-film-deposition system used to produce multilayer dielectric thin-film coatings with highly uniform thickness over a full NIF aperture. By using a theoretical model to optimize deposition parameters, uniformity measurements performed on a mapping laser photometer demonstrate nonuniformities of 0.45% over a 0.89-m aperture, after discounting a roll-off effect that may be eliminated by modification of the coating tooling. This result significantly exceeds the uniformity requirement for the NIF coatings.

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

- C. Stoeckl, R. E. Bahr, B. Yaakobi, W. Seka, S. P. Regan, R. S. Craxton, J. A. Delettrez, R. W. Short, J. Myatt, A. V. Maximov along with H. Baldis of LLNL (p. 76) use multiple OMEGA laser beams to study the two-plasmon-decay instability, which is the predominant source of suprathermal electrons in direct-drive inertial confinement fusion experiments. The authors show for the first time that the total overlapped intensity governs the scaling of the suprathermal-electron generation regardless of the number of overlapped beams, in contrast to conventional theories that are based on the single-beam approximation.

- R. Epstein (p. 81) examines the classical Rayleigh–Taylor instability of the interface separating two homogeneous inviscid fluid layers undergoing uniform acceleration, giving particular attention to the effects of uniform isentropic compression of the fluids and geometrical convergence of the interface and to the role of these effects in the implosion of inertial confinement fusion (ICF) capsules. The formulation presented makes a formal distinction between perturbation behavior under acceleration and perturbation behavior as modified by compression and by convergence of a cylindrical or spherical interface.

- K. Anderson and R. Betti (p. 91) develop the theoretical basis for laser-induced adiabat shaping in ICF spherical targets by a technique referred to as "relaxation." In this approach, the density profile of the capsule's shell is shaped using a weak prepulse followed by a main pulse with a high-intensity foot. The required laser pulse shape is easier to implement on current laser systems than the alternate technique described in the article. Rayleigh–Taylor growth rates are reduced without significantly degrading 1-D capsule performance.

- S. G. Lukishova (The Institute of Optics) and A. W. Schmid (LLE) along with A. J. McNamara, R. W. Boyd, and C. Stroud, Jr. of The Institute of Optics (p. 97) demonstrate the operation of a single-photon source—a key hardware element of quantum information technologies—via photon antibunching in the fluorescence of single terrylene molecules embedded in a cholesteric liquid crystal host. Planar-aligned cholesteric layers provide a one-dimensional photonic band gap, allowing an enhancement of the source efficiency.

- B. Yaakobi, T. R. Boehly, F. J. Marshall, D. D. Meyerhofer, R. Epstein, T. J. B. Collins, and D. Salzmann along with B. A. Remington and S. Pollaine of LLNL (p. 107) study the properties of compressed titanium due to laser-launched shocks by use of extended x-ray absorption fine structure (EXAFS). The EXAFS absorption spectrum is produced when backlighting a CH-coated Ti foil by the spectrally smooth radiation from a CH shell imploded on the 60-beam OMEGA laser system. Fitting an EXAFS model to the data indicates compression by a factor of 1.3, in agreement with shock-speed measurements and with hydrodynamic simulations. The rate of decay of the modulation with wave number is shown to include a significant contribution from static disorder, in addition to thermal vibration, due possibly to an α-Ti to ω-Ti crystal phase transition.

- Filling and cooling thin-walled (<3-μm) cryogenic capsules with deuterium–tritium fuel is a critical phase of operation for providing direct-drive targets. Permeation filling at room temperature to high pressures subjects the capsules to a buckling force. In addition, during cooling to 20 K, buckling and burst forces develop due to transient thermal gradients, thermal expansion differences, and changing permeability of the capsule wall. E. L. Alfonso, R. Q. Gram, and D. H. Harding (p. 118) quantify the forces on the capsule by modeling the thermal conditions inside the permeation cell. Results of cooldown cycles of OMEGA cryogenic targets agreed well with the simulation, and a cooling program was devised whereby the time for a capsule to reach the frozen state was reduced by 30%.

- A qualitative understanding of the greenhouse effect has long been available through models based on globally and time-averaged quantities. L. E. Schmidt (University of Rochester), H. L. Helfer, and R. S. Knox (LLE and University of Rochester) (p. 128) examine a simple 864-cell climatological model that reproduces yearly average temperatures obtained earlier from one of these global models and predicts a locally distributed nonradiative flux when observed temperatures are employed as input data. The model emphasizes vertical radiative energy transport within each cell and is a useful stepping stone for learning about radiative energy transfer into and out of Earth’s atmosphere.

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Editor