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Contents

In Brief

This volume of the LLE Review, covering January–March 2010, features "Photoswitchable Gas Permeation Membranes Based on Liquid Crystals" by E. Głowacki, K. Horovitz, C. W. Tang, and K. L. Marshall. In this article (p. 63), the authors report the fabrication of switchable gas permeation membranes in which a photoswitchable low-molecular-weight liquid crystalline (LC) material acts as the active element. Liquid crystal mixtures are doped with mesogenic azo dyes and infused into commercially available track-etched membranes with regular cylindrical pores (0.40 to 10.0 μm). Tunability of mass transfer can be achieved through a combination of (1) LC/mesogenic dye composition, (2) surface-induced alignment, and (3) reversible photoinduced LC-isotropic transitions. Photo-induced isothermal phase changes in the imbibed material afford large and fully reversible changes in the permeability of the membrane to nitrogen. Both the LC and photogenerated isotropic states demonstrate a linear permeability/pressure relationship, but they show significant differences in their permeability coefficients. Liquid crystal compositions can be chosen such that the LC phase is more permeable than the isotropic—or vice versa—and can be further tuned by surface alignment. Permeability switching response times are 5 s, with alternating UV and >420-nm radiation at an intensity of 2 mW/cm^2 being sufficient for complete and reversible switching. Thermal and kinetic properties of the confined LC materials are evaluated and correlated with the observed permeation properties. This is the first demonstration of reversible permeation control of a membrane with light irradiation.

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

- W. Theobald, S. Ivancic, B. Eichman, P. M. Nilson, J. A. Delettrez, R. Yan, G. Li, F. J. Marshall, D. D. Meyerhofer, J. F. Myatt, C. Ren, T. C. Sangster, C. Stoeckl, and J. D. Zuegel (LLE), V. Ovchinnikov, L. Van Woerkom, and R. R. Freeman (Ohio State University), and K. U. Akli, E. Giraldez, and R. B. Stephens (General Atomics) present experiments of high-intensity, short-pulse laser–plasma interactions with small-mass copper (Cu) wedge-shaped–cavity targets (p. 72). Experimental diagnostics provided spatially and spectrally resolved measurements of the Cu K_α line emission at 8 keV. The coupling efficiency of short-pulse laser energy into fast electrons was inferred from the x-ray yield for wedge opening angles between 30° and 60° and for *s*- and *p*-polarized laser irradiation. Up to 36±7% coupling efficiency was measured for the narrowest wedge with *p*-polarization. The results are compared with predictions from two-dimensional particle-in-cell simulations.

- I. V. Igumenshchev, D. H. Edgell, V. N. Goncharov, J. A. Delettrez, A. V. Maximov, J. F. Myatt, W. Seka, A. Shvydky, S. Skupsky, and C. Stoeckl model crossed-beam energy transfer in inertial confinement fusion implosions on OMEGA (p. 79). Radiative hydrodynamic simulations of implosion experiments on the OMEGA Laser System show that energy transfer between crossing laser beams can significantly reduce laser absorption. A new quantitative model for crossed-beam energy transfer has been developed, allowing one to simulate the coupling of multiple beams in the expanding corona of implosion targets. Scattered-light and bang-time measurements show good agreement with predictions of this model when nonlocal thermal transport is used. The laser absorption can be increased by employing two-color light, which reduces the crossed-beam energy transfer.

- V. Okishev (LLE), D. Wang, L. Shterengas, and G. Belenky (State University of New York at Stony Brook), and D. Westerfeld (Power Photonic Corporation) report on highly stable, room-temperature, mid-IR, GaSb-based laser diodes (p. 85). Such laser diodes have been characterized at various temperatures and driver currents. Up to 54 mW of output laser power was demonstrated in a 3150- to 3180-nm wavelength range with <20-nm FWHM spectral width.

- H. X. Vu (University of California, San Diego), D. F. DuBois and D. A. Russell (Lodestar Research Corporation), and J. F. Myatt (LLE) present an extension of the fully kinetic, reduced-description, particle-in-cell (RPIC) methodology to model two-plasmon-decay instability (TPD) (p. 88). This work is motivated by the recent resurgent interest in suprathermal electron generation by TPD in direct-drive laser fusion. RPIC provides a computationally efficient, fully kinetic simulation tool, especially in nonlinear regimes where Langmuir decay instability (LDI) is a dominant saturation mechanism. This RPIC methodology is an extension of the modeling of laser–plasma instabilities in underdense plasmas reported previously. The relationship between RPIC and the extended Zakharov model previously used for TPD is explored theoretically and tested in simulations. The modification of the electron velocity distribution—in particular, the generation of hot electrons—as calculated in RPIC leads to weakening of the wave turbulence excited by TPD compared to the Zakharov model predictions but the locations in wave vector space of important spectral features, e.g., arising from the LDI, of the nonlinear wave fluctuations are exactly the same in the two approaches. New results involving two oblique, overlapping laser beams, a common geometrical feature in direct-drive schemes, are presented. The two laser beams can cooperatively excite common primary Langmuir waves, which initiate the LDI process.

Kenneth S. Anderson
Editor