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LLE Review

Quarterly Report

Contents

In Brief

This volume of the LLE Review, covering July–September 2009, features a summary and report on the first Omega Laser Facility Users Group (OLUG) Workshop organized by the Executive Committee: R. D. Petrasso (Plasma Science and Fusion Center, MIT), H. Baldis (University of California–Davis), J. Cobble (LANL), P. Drake (University of Michigan), J. Knauer (LLE), R. Mancini (University of Nevada–Reno), P. Norreys (Rutherford Appleton Laboratory), and M. Schneider (LLNL) (p. 161). More than 100 researchers from 29 universities and laboratories and 4 countries gathered at the Laboratory for Laser Energetics (LLE) from 29 April–1 May 2009 for the three-day workshop to facilitate communication and exchanges among individual Omega users and between users and LLE; to present ongoing and proposed research; to encourage research opportunities and collaborations that could be undertaken at the Omega Facility and in a complementary fashion at other facilities (such as LULI or the NIF); to provide an opportunity for students and postdoctoral fellows to present their research at the Omega Laser Facility in an interactive, yet congenial, atmosphere; and to provide feedback to LLE from the users about ways to improve the facility and future experimental campaigns. Invited talks on the Facility and science were given. The six overview science talks described the breadth and excitement of high-energy-density (HED) science undertaken on OMEGA, both present and future. The final overview talk concerned the role and importance of science to the National Nuclear Security Administration (NNSA) mission. Thirty-two students and postdoctoral fellows attended the workshop and presented 31 of the 48 contributed poster and oral presentations. The presentations ranged from target fabrication to simulating important aspects of supernovae. An important function of the workshop was to develop a set of recommendations and findings to guide future priorities for OMEGA. The original report and management's response are described beginning on p. 168. LLE management will use these recommendations as a guide for making decisions about OMEGA operations, priorities, and future capabilities. Another highlight of the workshop was the student/postdoctoral panel that discussed their experiences at the Omega Facility and their thoughts and recommendations on Facility improvements. Wide-ranging and engaging discussions resulted in the student/postdoctoral report contained in Findings and Recommendations of the Student/Postdoctoral Panel (p. 176).

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

- T. R. Boehly, W. Seka, T. C. Sangster, D. D. Meyerhofer (LLE), R. E. Olson (Sandia National Laboratory), and P. M. Celliers, D. H. Munro, O. L. Landen, G. W. Collins, L. J. Suter (LLNL), describe the effect of condensates and inner coatings on the performance of vacuum hohlraum targets (p. 178). Experiments on the OMEGA Laser System using laser-driven vacuum hohlraum targets show distinct differences between cryogenic (<20 K) and warm targets. Warm hohlraum targets coated with 2 μm of CH replicate the behavior of cryogenic targets. This indicates that cryogenic hohlraums are affected by the condensation of background gases on the cold hohlraum surface. The introduction of low-Z material into the hohlraums significantly reduces the x-ray conversion efficiency, resulting in lower hohlraum radiation temperature. The coatings (both CH and condensates) produce long-scale-length, low-Z plasmas that reduce the absorption of laser light in the hohlraums. This causes higher reflectivity and produces hot electrons that generate hard x rays ($h\nu > 20$ keV), both of which are detrimental to the performance of hohlraum-driven inertial confinement fusion targets.

- S. N. Shafrir, H. J. Romanofsky, M. Skarlinski, M. Wang, C. Miao, S. Salzman, T. Chartier, J. Mici, R. Shen, S. D. Jacobs (LLE), J. C. Lambropoulos (Department of Mechanical Engineering, University of Rochester), and H. Yang (Department of Chemical Engineering, University of Rochester), report on magnetorheological finishing (MRF) spotting experiments performed on glasses and ceramics using a zirconia-coated-carbonyl-iron-particle–based magnetorheological (MR) fluid (p. 190). The coating layer was ~50 to 100 nm thick, faceted in surface structure, and well adhered. Coated particles showed long-term stability against aqueous corrosion. A viable MR fluid was prepared simply by adding water. Spot-polishing tests were performed on a variety of optical glasses and ceramics over a period of nearly three weeks with no signs of MR fluid degradation or corrosion. Stable material-removal rates and smooth surfaces inside spots were obtained.

- L. Sun and J. R. Marciante (LLE), and S. Jiang (AdValue Photonics, Inc.), demonstrate an all-fiber optical magnetic field sensor (p. 206). It consists of a fiber Faraday rotator and a fiber polarizer. The fiber Faraday rotator uses a 2-cm-long section of 56-wt%-terbium-oxide–doped silica fiber, and the fiber polarizer is a Corning SP1060 single-polarization fiber. The all-fiber optical magnetic field sensor has a sensitivity of 0.45 rad/T and can measure a magnetic field up to 3.5 T.

- J. Zhang and R. Sobolewski (Department of Electrical and Computer Engineering, University of Rochester and LLE), and A. Belousov, J. Karpinski, B. Batlogg (Laboratory for Solid State Physics, ETH Zurich), report their experimental studies on the time-resolved carrier dynamics in high-quality $Al_{0.86}Ga_{0.14}N$ single crystals, grown using a solution technique in a high-nitrogen-gas-pressure system (p. 210). Optical measurements were performed using two-color, femtosecond pump–probe spectroscopy. By studying the correlation signal amplitude's dependence on both the pump light's absorbed power and wavelength, they obtained a two-photon-absorption coefficient $\beta = 0.442 \pm 0.02$ cm/GW, as well as its spectral dependence, and confirmed that within the tuning range of the laser, the latter was in very good agreement with the Sheik–Bahae theory for wide, direct-bandgap semiconductors. The optical bandgap of the $Al_{0.86}Ga_{0.14}N$ crystal was determined to be 5.81 ± 0.01 eV.

- This volume concludes with a summary of LLE's Summer High School Research Program (p. 214), the FY09 Laser Facility Report (p. 216), and the National Laser Users' Facility and External Users' Programs (p. 218).

Dana H. Edgell
Editor