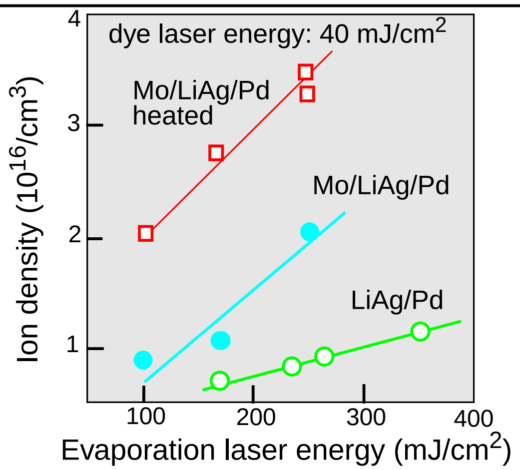
March 1995 Highlights of the Light Ion Inertial Confinement Fusion Program



Effects of adding Mo to increase laser absorption and of heating LiAg layer to remove contaminants.

Preparations for RF discharge cleaning of the lithium emission surface on PBFA II continue. The hardware to heat the anode arrived. A cable connected to the discharge cleaning hardware fails at 200 watts because of a mismatch between the 600-watt RF generator and the cleaning plasma. After we solve this problem, experiments to clean the active Laser EVaporation Ion Source (LEVIS) will commence. In the meantime, we have developed thin-film anode coatings that meet the requirements of LEVIS for the new PBFA-II barrel diode. With these lower reflectance coatings, the laser can release lithium from a larger anode surface area than with traditional thin-film coatings. The new coatings consist of a LiAg source layer, with a barrier layer of LiF, MgF_2, or Pd between the anode and the LiAg, and a Mo or Pd overcoat to increase absorption of the 100 mJ/cm^2 laser light. With these overcoats, ion densities of 1 - 2 x 10^{16}/cc in a 1-mm-thick layer have been measured in the light laboratory from unheated or 200°C anodes (see figure).

A QUICKSILVER simulation illustrates an important new result: diode geometries with initially nonuniform emission of Li^+ can cause premature transition to the ion mode electromagnetic instability. This has implications for the extraction ion diodes required for high-yield ICF, since it is more difficult to achieve uniform beam current density if ions are axially, rather than radially, focused. A key contributor to this difficulty, however, is the passive LiF source: simulations with active sources show uniform current density and a low divergence phase can be achieved in extraction geometry. Furthermore, in an extraction ion diode, magnetic streamlines cause electrons to go to the inside edge of the active anode region; hence, these diodes are more amenable to the use of electron limiters to control diode instabilities.

The plasma formed on the symmetry axis of an imploding plasma load, or z pinch, produces a large-scale soft x-ray source that can be used to study processes dominated by radiative heating. During a recent two-week experimental series on the 2-MV, 20-TW Saturn accelerator, a brightness temperature of 71 eV was measured in a 2-cm-diameter, 2.4-cm-long cylindrical hohlraum driven by x-rays produced from a z-pinch implosion. We are evaluating the potential of such an imploding plasma as a radiation source for experiments relevant to the National Ignition Facility, weapons physics, and high-yield fusion physics.

Ion beam nonuniformity affects diode operation, growth of microdivergence, and the ability to transport the beam. We are reviewing nonuniformity data in the charge neutral, gas transport, and target regions of past and present accelerators (Gamble II, Nereus, Proto I, LION, ALIAS, SABRE, PBFA II) and suggesting methods to improve uniformity and to obtain more data. Possible new diagnostics to develop are scintillator/streak cameras, activation, ion framing cameras, and a diagnostic based on the absorption of reflected laser light in an underdense plasma.

Contact: Jeff Quintenz, Inertial Confinement Fusion Program, Dept. 1202, 505-845-7245, fax: 505-845-7464, email: jpquint@sandia.gov

Highlights are prepared by Mary Ann Sweeney, Dept. 1241, 505-845-7307, fax: 505-845-7890, email: masween@sandia.gov.
Archived copies of the *Highlights* beginning July 1993 are available at http://www.sandia.gov/pulspowr/hedicf/highlights.