Collimation Effects on Magnetically Confined Laser Produced Plasmas

Niral Shah, Purdue University; Nick McKenna, Purdue University; Faisal Odeh, Purdue University; Prasoon Diwakar, Purdue University; Fillipo Genco, Purdue University; Sivanandan Harilal, Purdue University; Syed Hassan, Purdue University;
and Ahmed Hassanein, Purdue University

Tokamaks for fusion research are extremely complex and are still limited by inherent instabilities such as material erosion from plasma instabilities. Due to the lack of data and high demand of resources, simulations to portray Tokamaks are essential. A Particle-In-Cell (PIC) simulation for plasma erosion on materials within the Tokamak is to be benchmarked using the experimental data obtained in these experiments. The effects of an axial magnetic field (magnetic field lines are along the plasma propagation direction) on an expanding laser produced plasma plume are investigated. A Continuum Surelite Nd:YAG laser system at 1064 nm wavelength and 6 ns full width half max (FWHM) is used to ablate carbon, aluminum, and boron nitride surfaces in the presence of a magnetic field (~.6T) at 50 mJ, 100 mJ, and 150 mJ under vacuum. The resulting plasma plume is studied using fast photography by employing an intensified charge coupled device (ICCD). The effect of the axial magnetic field changes with the target material. Carbon plume undergoes the creation of side wings that expand perpendicular to the field and curve back into the field after the primary plume has expanded and dissipated. Both aluminum and boron nitride exhibit significant focusing at the center of the magnetic field with no evidence of wings formation. Further work using optical emission spectroscopy is in progress to obtain temperature, electron density, and ionization rate of the laser produced plasma plumes to better understand the mechanism of wing formation as well as plume focusing in different materials.