VARIABLE THICKNESS LIQUID CRYSTAL THIN FILM TARGETS FOR OPTIMIZED LASER PLASMA INTERACTION

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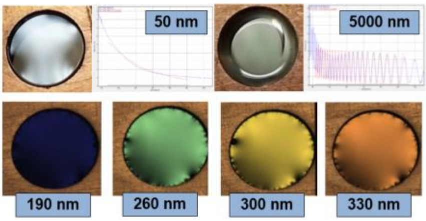
We have developed a new technology for forming low-Z, thin liquid crystal film targets and inserting them into an intense laser focus. The target thickness can be varied from 10 nm to 10 μm with a positional reproducibility better than 2 μm along the laser focus and at a repetition rate exceeding 0.3 Hz. Operation at repetition rates of 10 Hz or more is being developed. These targets will facilitate experiments using the current and next-generation high repetition rate, high power lasers for fundamental studies of the intense laser-plasma interaction as well as applications involving the generation of secondary radiation.

The surface tension inherent to the smectic liquid crystal phase naturally forms freely suspended films within a rigid frame. Thickness control is achieved on-demand by regulating the temperature and volume of liquid crystal during film formation. These techniques and the capability of liquid crystal films as low-Z ion acceleration targets have been demonstrated previously. [1]

In addition to high repetition rate applications, liquid crystal films are ideal for studying laser-plasma interaction phenomena that rely on target thickness, including ion acceleration mechanisms. Recent work with these targets on the selection and optimization of such thickness-dependent mechanisms will be presented.



The first simulations on liquid crystal film targets will also be shown. 1D and 2D simulations using the PIC code LSP have been performed to investigate ion acceleration in various liquid crystal target thickness regimes. In particular, we have modeled the accelerated hydrogen and carbon ion spectra as well as the transmitted light as a function of peak intensity, pulse duration, and target thickness. After verifying simulation convergence, we identify the fields responsible for the acceleration mechanism.

[1] P. L. Poole *et al. Phys. Plasmas* **21** 063109 (2014).