SAND2010-1266C

Title:
Dual Wavelength Laser Damage Testing of Dichroic Pump Optics for High Energy Lasers

Authors: M. Kimmel, P.Rambo, J.Schwarz, and B. Atherton

Abstract:
Numerous laser-based sources such as Ti:Sapphire and Optical Parametric Amplifiers (OPA's) require optical pumping from another laser source. As these systems evolve towards higher energies, fundamental material properties such as the laser-induced damage threshold (LIDT) of the optics limit the overall system performance. In OPA's, the dichroic pump optic for combining this pump beam with the seed beam will see a high fluence from combined simultaneous laser exposure. The same issue holds for any subsequent harmonic separator after the OPA, making such dichroics the most likely failure node in these systems. Only recently have researchers begun to explore such concerns, looking at individual and simultaneous exposures to fundamental and third-harmonic light from Nd:YAG [1]. This scenario is relevant for high energy fusion lasers. However, to our knowledge, measurements of simultaneous dual wavelength damage thresholds on such optics have not been performed for exposure to fundamental and second-harmonic light, a situation more common in OPA's .

The Z-Backlighter Facility at Sandia National Laboratories operates and OPA variant wherein the OPA is seeded with chirped light at 1054nm in 2.5ns and is pumped by 532nm light in 4ns. The facility also has an instrumented damager tester setup to examine the issues of laser-induced damage thresholds in a variety of situations [2] . Using this damage tester, we have measured the LIDT of several commercial pump dichroics under individual and simultaneous wavelength exposures with chirped 1054nm light and 532nm light.

This paper will present LIDT results for Dichroic pump optics from 2 different commercial suppliers of dielectric coated laser optics. The samples were fused silica substrates with multilayer dielectric coatings optimized for 45 degree reflection of "S" polarized 1054nm center wavelength laser light and transmission of "P" polarized 532nm laser light on the front surface, with anti-reflection coatings for "P" polarized 532nm laser light applied to the second surface.

The LIDT for each sample was measured with fundamental and second-harmonic light individually, and then again with both beams combined collinearly and cotemporally, for a total of 3 LIDT measurements for each sample. The LIDT results presented in this paper show a large difference between the 2 vendors samples, with results of 16J/cm^2 and 14.6 J/cm^2 comparing well with fundamental light, but differing greatly with second-harmonic LIDT of 2.6J/cm^2 and 14.3 J/cm^2 respectively, and becoming even greater with fundamental and second-harmonic combined, with LIDT results of 1.3J/cm^2 and 14.6J/cm^2 respectively.

These tests show a large variability in LIDT results between optics of similar specification from different vendors. Possible sources of the difference are coating material selections and electric field enhancement in the coating design. Such issues must be carefully taken into account in order to design the next generation of high energy lasers.

[1] M. Zhou *et al.*, Optics Communications **282**, 3132 (2009).
[2] M. Kimmel *et al.*, edited by J. E. Gregory *et al.* (SPIE, 2009), p. 75041G.