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Picosecond Laser Damage Testing In-Vacuum for the Advanced Radiographic Capability

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witness optic to the chamber under vacuum [10]. During this exposure VOCs are absorbed into the pores of the sol-gel coating and reduce the optical transmission through the witness optic. The sol-gel coating is optimized for 526 nm and the change in transmission at this wavelength is measured with a spectrophotometer. We have limited the amount of VOCs to a level that produces less than 0.1% change in the sol-gel witness transmission in 100 hours of exposure at a vacuum of 10^{-4} torr or less.Figure 1a shows 1 ps LID test results of an ARC MLD grating witness sample performed in vacuum at the 76.5 degree use angle. The damage probability is determined by sorting and normalizing the damage fluences for 20 R-on-1 test sites. It was observed with the online microscope that during the R-on-1 test, damage first occurs in a small area and rapidly grows to a significant fraction of the beam size. Fig. 1a also shows the $\rho(\phi)$ from a raster scan of a 1 cm^2 area. A fit of the data is projected to estimate the low end of the $\rho(\phi)$ curve. Significant damage densities occur at fluences below the lowest R-on-1 damage site experimentally demonstrating the necessity of large area testing. Figure 1b shows a scanning electron microscope (SEM) image of ARC MLD witness grating damage from the raster scan. The laser approaches the sample from the right side and is rastered in vertical columns going from left to right. In this case laser irradiation of a pre-existing crater in the MLD stack caused destruction of the adjacent grating lines and significant growth in the horizontal direction.

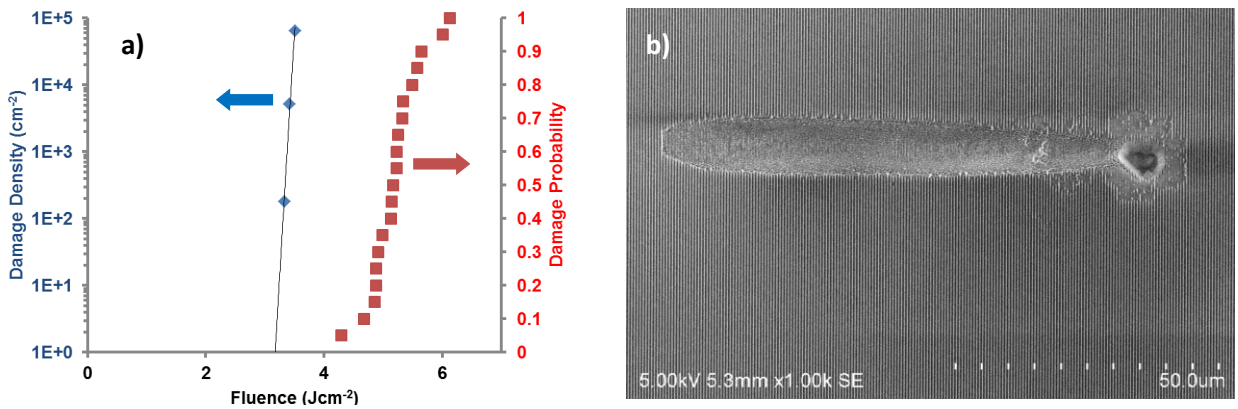

Fig. 1. a) Damage probability curve of an ARC grating sample in vacuum from an R-on-1 test (red squares) and damage density as a function of fluence ($\rho(\phi)$) from a raster scan (blue diamonds) using a 1 ps laser. The line is a fit to the data projected to estimate fluence of low damage densities. b) A SEM image of a damage site from a raster scan.

We have developed an in-vacuum LID test station to measure ARC final optics with 1-50 ps duration pulses. Initial testing of ARC grating samples indicates that raster scanning large areas with low fluence is required to better predict full-scale performance. Details of the test station, vacuum chamber contamination and the initial tests of ARC final optics will be discussed.

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