

High Power Laser Science and Engineering, (2019), Vol. 7, e7, 6 pages.

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doi:10.1017/hpl.2018.62

Cumulative material damage from train of ultrafast infrared laser pulses

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(Received 31 July 2018; revised 5 October 2018; accepted 13 November 2018)

Abstract

We developed a systematic experimental method to demonstrate that damage threshold fluence (DTF) for fused silica changes with the number of femtosecond laser (800 nm, 65 ± 5 fs, 10 Hz and 600 Hz) pulses. Based on the experimental data, we were able to develop a model which indicates that the change in DTF varies with the number of shots logarithmically up to a critical value. Above this value, DTF approaches an asymptotic value. Both DTF for a single shot and the asymptotic value as well as the critical value where this happens, are extrinsic parameters dependent on the configuration (repetition rate, pressure and geometry near or at the surface). These measurements indicate that the power of this dependence is an intrinsic parameter independent of the configuration.

Keywords: laser-induced breakdown; laser damage; lasers and laser optics