LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

LIDT ISO S-ON-1 TEST PROCEDURE

SAMPLE: CAM364-B1-5

Request from	
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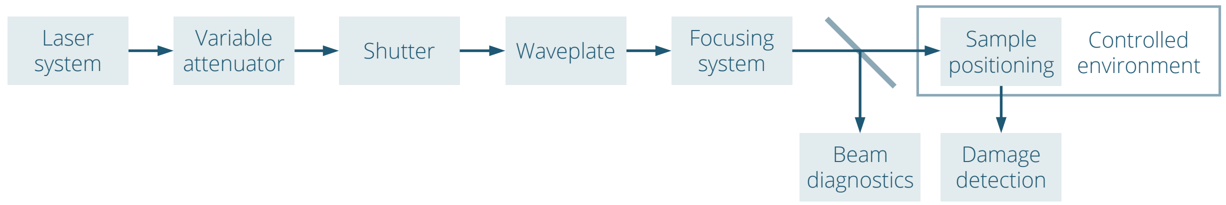
Contact person	Vaida Grašytė
Inquiry date	2025-10-03
Purchase order	PO13301

Testing institute	
Address	UAB Lidaris Saulėtekio al. 10 LT-10223 Vilnius Lithuania
Tester	Dovilė Pamedytytė
Test date	2025-10-09
Sale order	SO06310
Test ID	KGPBVP

Specimen	
Name	CAM364-B1-5
Front surface (S1)	AR Coating (AR@1064)
Rear surface (S2)	Uncoated
Dimensions	Ø25.4 x 6.4 mm
Packaging	Plastic box

TEST EQUIPMENT

Test setup

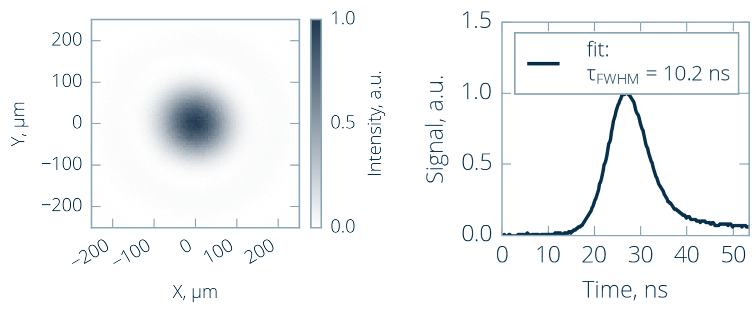


Laser and its parameters

Type	Q-switched, seeded Nd:YAG (IL)
Manufacturer	InnoLas Laser II
Model	SpitLight Hybrid
Central wavelength	1064.0 nm
Angle of incidence	0.0 Deg
Polarization state	Linear (AoI = 0)
Pulse repetition frequency	100 Hz
Spatial beam profile in target plane	Near Gaussian
Beam diameter in target plane ($1/e^2$)	(218.3 ± 1.4) µm
Longitudinal pulse profile	Single longitudinal mode
Pulse duration (FWHM)	(10.2 ± 0.3) ns
Pulse to pulse energy stability (SD)	1.3 %

Energy/power meter

Manufacturer	Ophir
Model	PE50-DIF-C
Calibration due date	2025-10-31



(a) Beam profile (b) Pulse profile

Figure 1. Laser parameters used for measurements.

TEST SPECIFICATION

Definitions and test description

Laser-induced damage (LID) is defined as any permanent laser radiation induced change in the characteristics of the surface/bulk of the specimen which can be observed by an inspection technique and at a sensitivity related to the intended operation of the product concerned. Laser-induced damage threshold (LIDT) is defined as the highest quantity of laser radiation incident upon the optical component for which the extrapolated probability of damage is zero. [1]

LID of the sample is investigated by performing a standardized S-on-1 test procedure.[2]
LIDT value is determined by fitting experimental damage probability data with a model derived for a Poisson damage process assuming degenerate defect ensemble. [3]

Test sites

Number of sites	410
Arrangement of sites	Hexagonal
Minimum distance between sites	0.9 mm
Maximum pulses per site	1000

Analysis information

Online detection	Scattered light diode
Offline detection	Nomarski microscope
Software version	2e7b3c0b

Test environment

Environment	Air
Cleanroom class (ISO 14644-1)	ISO 7
Pressure	1.00e+03 mbar
Temperature	22 C
Humidity	39 %

Sample preparation

Storage before test	Normal laboratory conditions
Dust blow-off	None
Cleaning	None

[1] ISO 21254-1:2011: Lasers and laser-related equipment - Test methods for laser-induced damage threshold - Part 1: Definitions and general principles, International Organization for Standardization, Geneva, Switzerland (2011)
[2] ISO 21254-2:2011: Lasers and laser-related equipment - Test methods for laser-induced damage threshold - Part 2: Threshold determination, International Organization for Standardization, Geneva, Switzerland (2011)
[3] J. Porteus and S. Seitel, Absolute onset of optical surface damage using distributed defect ensembles, Applied Optics, 23(21), 3796–3805 (1984)

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LIDT TEST RESULTS

LIDT VALUE

1000-on-1	74^{+21}_{-43} J/cm^2

CHARACTERISTIC DAMAGE CURVE

Table 1: Estimated LIDTs from fiting model for sample CAM364-B1-5.

Test mode	Threshold (Offline detection)	Threshold (Online detection)
1-on-1	74^{+33}_{-43} J/cm^2	79^{+32}_{-37} J/cm^2
10-on-1	-	79^{+31}_{-37} J/cm^2
100-on-1	-	79^{+26}_{-37} J/cm^2
1000-on-1	74^{+21}_{-43} J/cm^2	79^{+21}_{-37} J/cm^2

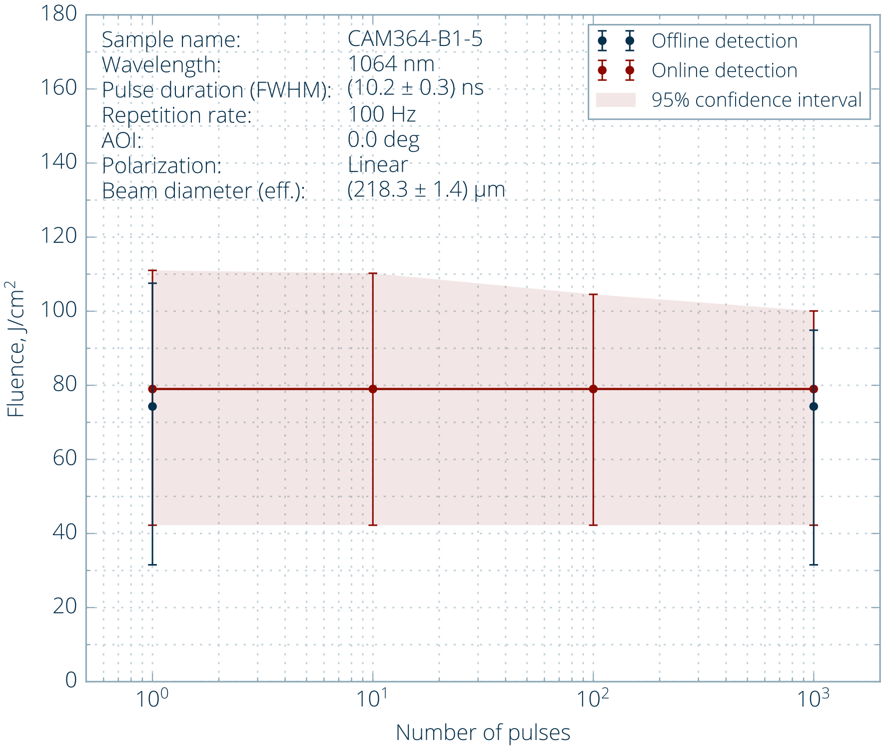
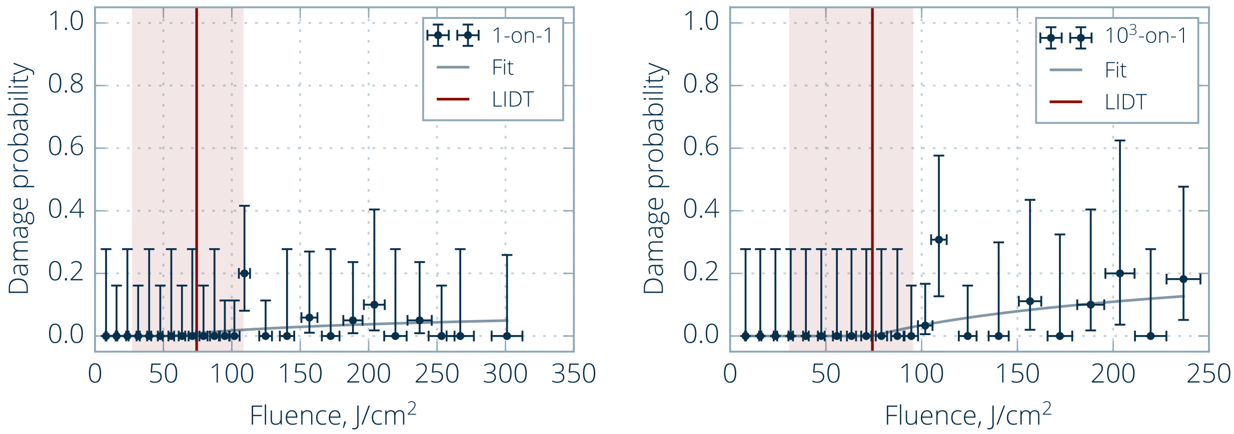


Figure 2. Characteristic damage curve.

DAMAGE PROBABILITY (OFFLINE DETECTION)



(a) 1-on-1

(b) 1000-on-1

Figure 3. Damage probability plots.

TYPICAL DAMAGE MORPHOLOGY (OFFLINE DETECTION)

Figure 4. Typical damage morphology: fluence 158 J/cm^2, damage after 1 pulse(s).

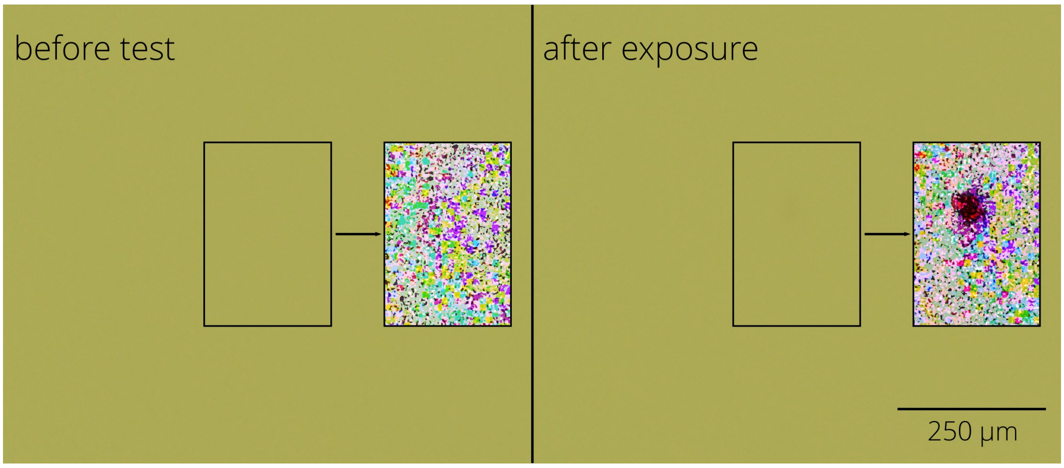
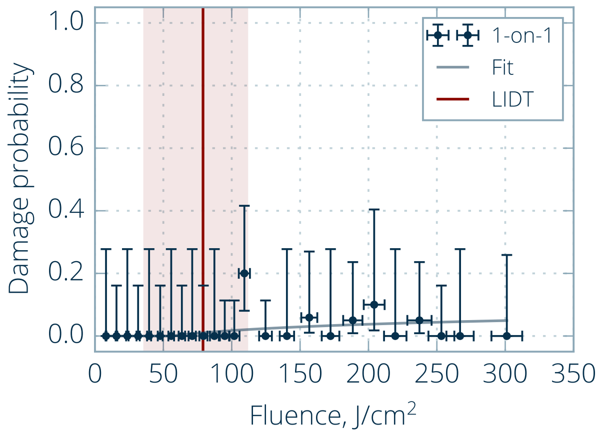
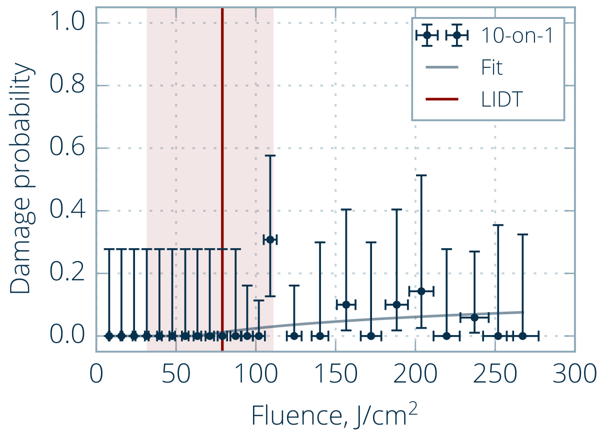


Figure 5. Typical damage morphology: fluence 102 J/cm^2, damage after 1000 pulse(s). High contrast image.

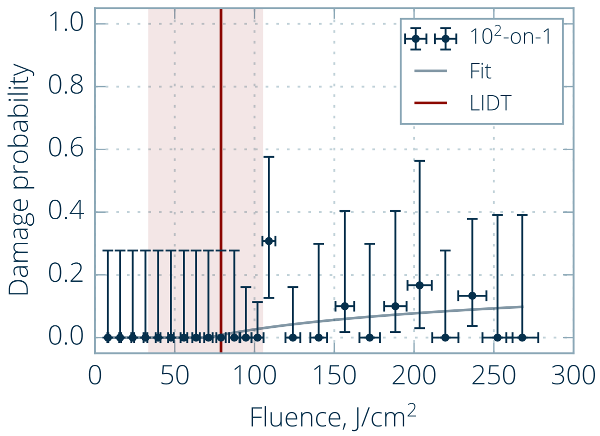
DAMAGE PROBABILITY (ONLINE DETECTION)



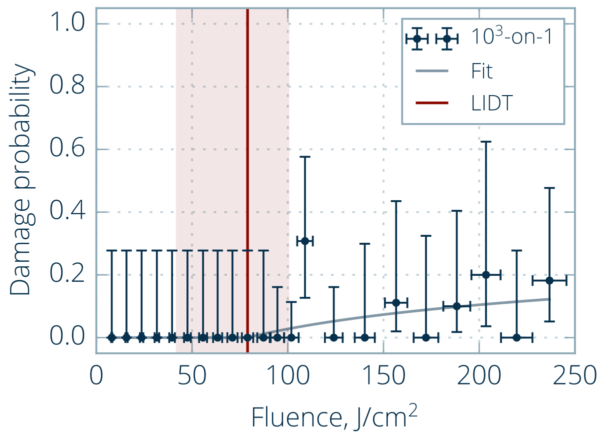
(a) 1-on-1



(b) 10-on-1



(c) 100-on-1



(d) 1000-on-1

Figure 6. Damage probability plots.

CUMULATIVE PROBABILITIES FITTED WITH LINEAR FIT MODEL

CUMULATIVE PROBABILITIES LIDT VALUE

1000-on-1	$96.1^{+5.4}_{-6.2}$ J/cm^2

CHARACTERISTIC DAMAGE CURVE

Table 2: Estimated LIDTs from cumulative probabilities using Linear fit model for sample CAM364-B1-5.

Test mode	Threshold (Offline detection)	Threshold (Online detection)
1-on-1	$100.9^{+4.9}_{-8.9}$ J/cm^2	$101.9^{+4.8}_{-9.0}$ J/cm^2
10-on-1	-	$101.9^{+4.8}_{-9.0}$ J/cm^2
100-on-1	-	$101.9^{+3.9}_{-9.3}$ J/cm^2
1000-on-1	$96.1^{+5.4}_{-6.2}$ J/cm^2	$101.8^{+3.6}_{-9.3}$ J/cm^2

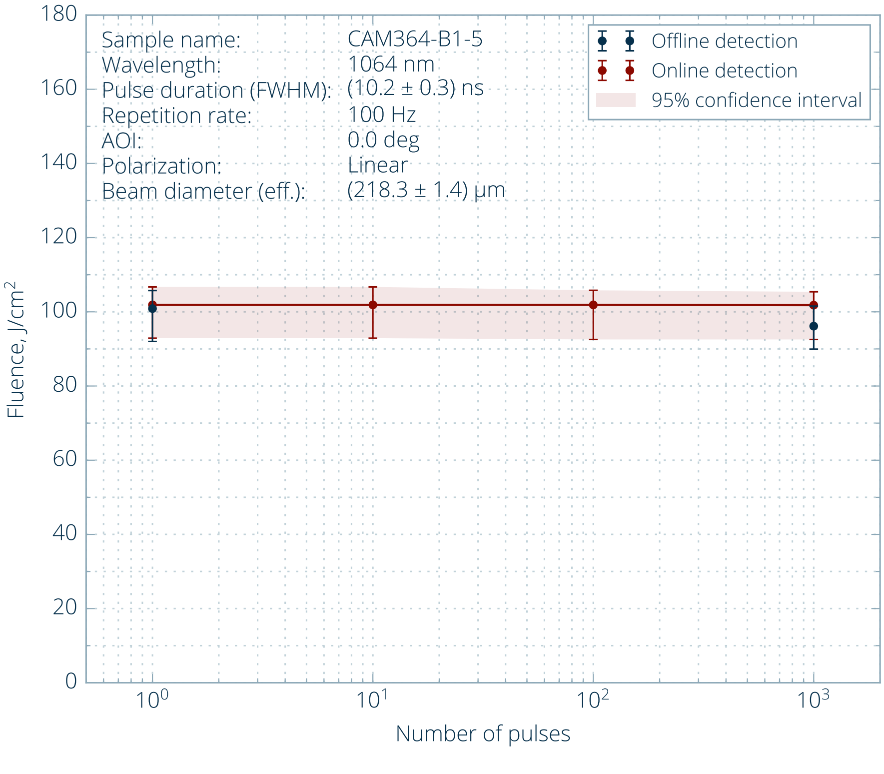
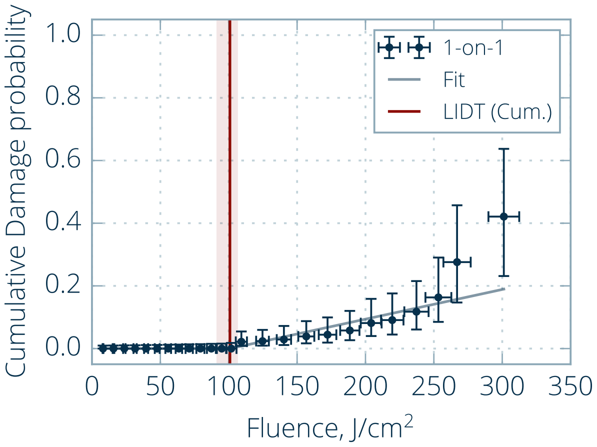


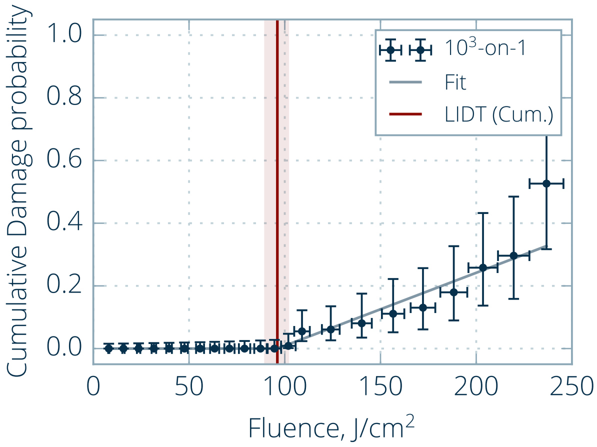
Figure 7. Characteristic damage curve for cumulative probabilities. [3]

[3]Read Technical Note 1

DAMAGE PROBABILITY (OFFLINE DETECTION)



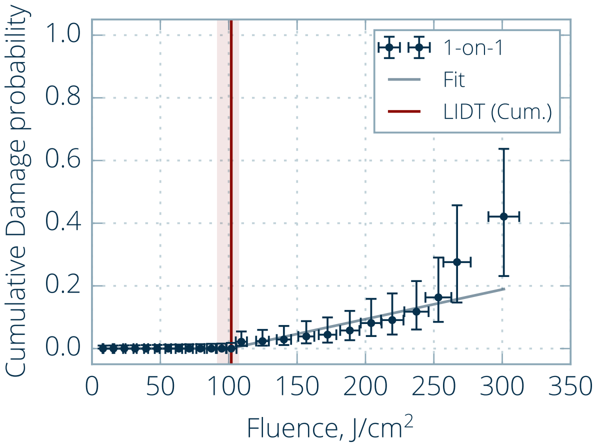
(a) 1-on-1



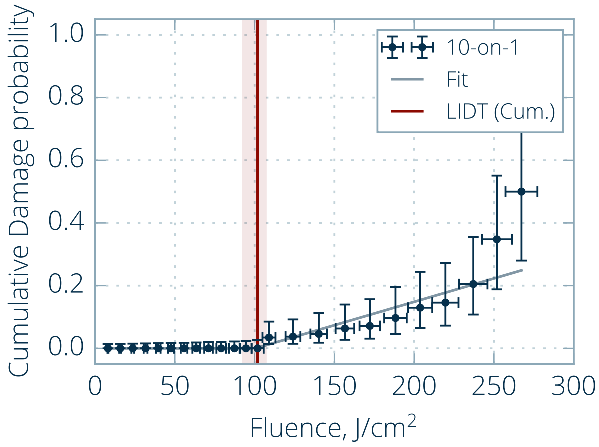
(b) 1000-on-1

Figure 8. Cumulative damage probability plots.

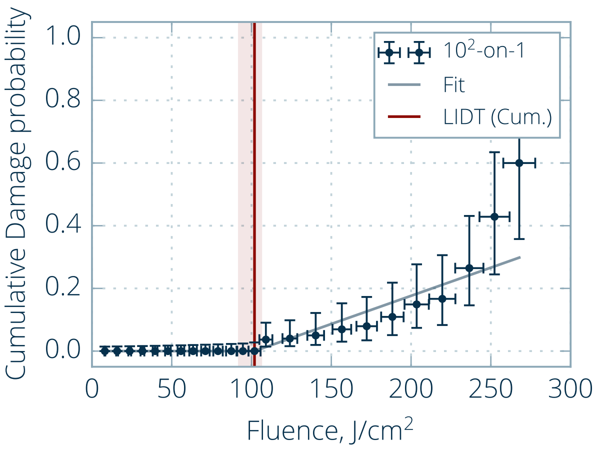
DAMAGE PROBABILITY (ONLINE DETECTION)



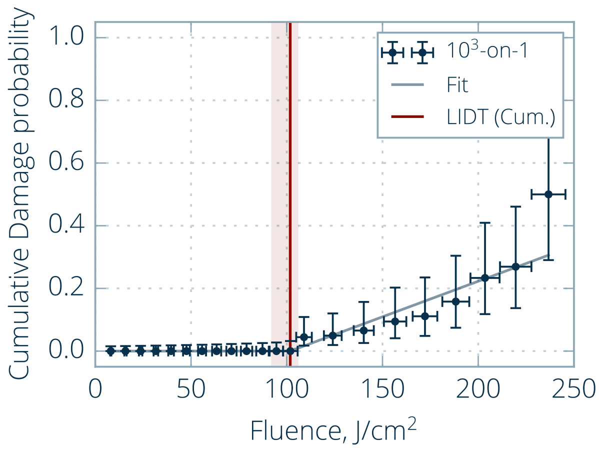
(a) 1-on-1



(b) 10-on-1



(c) 100-on-1



(d) 1000-on-1

Figure 9. Cumulative damage probability plots.

TECHNICAL NOTES

TECHNICAL NOTE 1: LIDT estimation for cumulative probabilities

In a case when the sample experiences relatively small number of damages, we introduce supplementary LIDT estimation for cumulative reduced probability distribution. Cumulative data reduction is performed considered following assumptions[4]. An undamaged test site would have also survived when irradiated at lower fluence. A damaged test site would have also been damaged when irradiated at higher fluence. Positive damage probabilities in reduced data is fitted with Linear function using maximum likelihood estimation. This method was included in the report because error of the highest pulse class LIDT value exceeded 50%.

TECHNICAL NOTE 2: Rear surface damage

Rear surface damage was observed exposing with more than 140 J/cm^2 fluence laser radiation.

[4] L. Jensen; M. Mrohs; M. Gyamfi; H. Mädebach; D. Ristau, Higher certainty of the laser-induced damage threshold test with a redistributing data treatment, Rev. Sci. Instrum. 1 October 2015; 86 (10): 103106.