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LIDT Service

LASER-INDUCED DAMAGE THRESHOLD (LIDT) MEASUREMENT REPORT

S-ON-1 (ISO 21254-2) TEST PROCEDURE

SAMPLE: SAMPLE 4

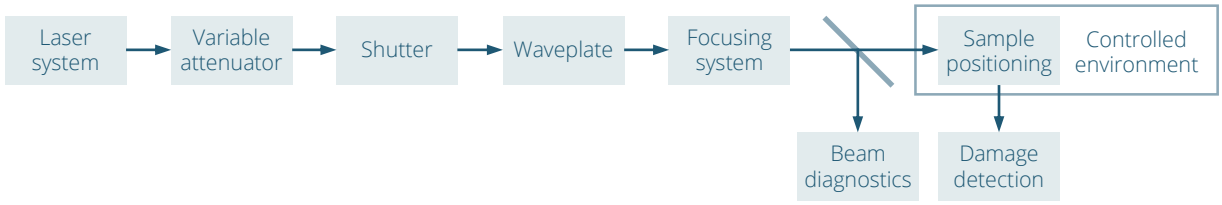
Request from	
Address	HOLO/OR 13B Einstein Street Science Park 7403617 Nes Tziona Israel
Contact person	Natan Kaplan
Purchase order	1903154

Testing institute	
Address	UAB Lidaris Saulėtekio al. 10 10223 Vilnius Lithuania
Tester	Lina Vigricaite
Test date	04/12/2019
Sale order	SO1580
Test ID	E1X8WE

Specimen	
Name	Sample 4
Type	AR Coating (V coating for 1064nm)
Packaging	Wrapped in paper

TEST EQUIPMENT

Test setup

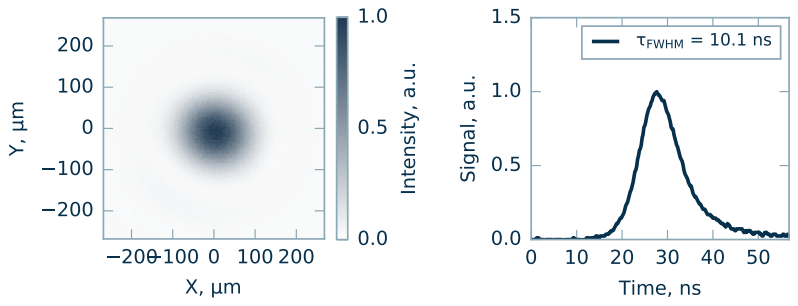


Laser and its parameters

Type	Q-switched, seeded Nd:YAG
Manufacturer	InnoLas Laser II
Model	SpitLight Hybrid
Central wavelength	1064.0 nm
Angle of incidence	0.0 deg
Polarization state	Linear
Pulse repetition frequency	10 Hz
Spatial beam profile in target plane	TEM00
Beam diameter in target plane ($1/e^2$)	(235.1 ± 2.5) µm
Longitudinal pulse profile	Single longitudinal mode
Pulse duration (FWHM)	(10.1 ± 0.3) ns
Pulse to pulse energy stability (SD)	1.3 %

Energy/power meter

Manufacturer	Ophir
Model	PE50-DIF-C
Calibration due date	2020-07-01



(a) Beam profile (b) Pulse profile

Figure 1. Laser parameters used for measurements.

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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	900 µm
Maximum pulses per site	1000

Damage detection

Online	Scattered light diode
Offline	Nomarski microscope

Test environment

Environment	Air
Cleanroom class (ISO 14644-1)	ISO7
Pressure	1 bar
Temperature	20 C
Humidity	23 %

Sample preparation

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

[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)

LIDT TEST RESULTS

LIDT VALUE

10^3-on-1	11.03 $^{+0.59}_{-1.14}$ J/cm^2	6.95 $^{+0.37}_{-0.72}$ J/cm^2 (scaled to 4 ns)

CHARACTERISTIC DAMAGE CURVE

Table 1: Estimated LIDTs from fiting model for sample Sample 4.

Test mode	Threshold (Offline detection - microscopy)	Threshold (Offline detection - microscopy) scaled to 4 ns	Threshold (Online detection - scattering)	Threshold (Online detection - scattering) scaled to 4 ns
1-on-1	22.34 $^{+1.34}_{-3.02}$ J/cm^2	14.07 $^{+0.84}_{-1.90}$ J/cm^2	22.6 $^{+1.5}_{-3.4}$ J/cm^2	14.2 $^{+0.9}_{-2.2}$ J/cm^2
10-on-1	-	-	18.9 $^{+1.5}_{-3.4}$ J/cm^2	11.9 $^{+0.9}_{-2.1}$ J/cm^2
10^2-on-1	-	-	18.9 $^{+1.4}_{-3.4}$ J/cm^2	11.9 $^{+0.9}_{-2.1}$ J/cm^2
10^3-on-1	11.03 $^{+0.59}_{-1.14}$ J/cm^2	6.95 $^{+0.37}_{-0.72}$ J/cm^2	18.9 $^{+1.4}_{-3.4}$ J/cm^2	11.9 $^{+0.9}_{-2.1}$ J/cm^2

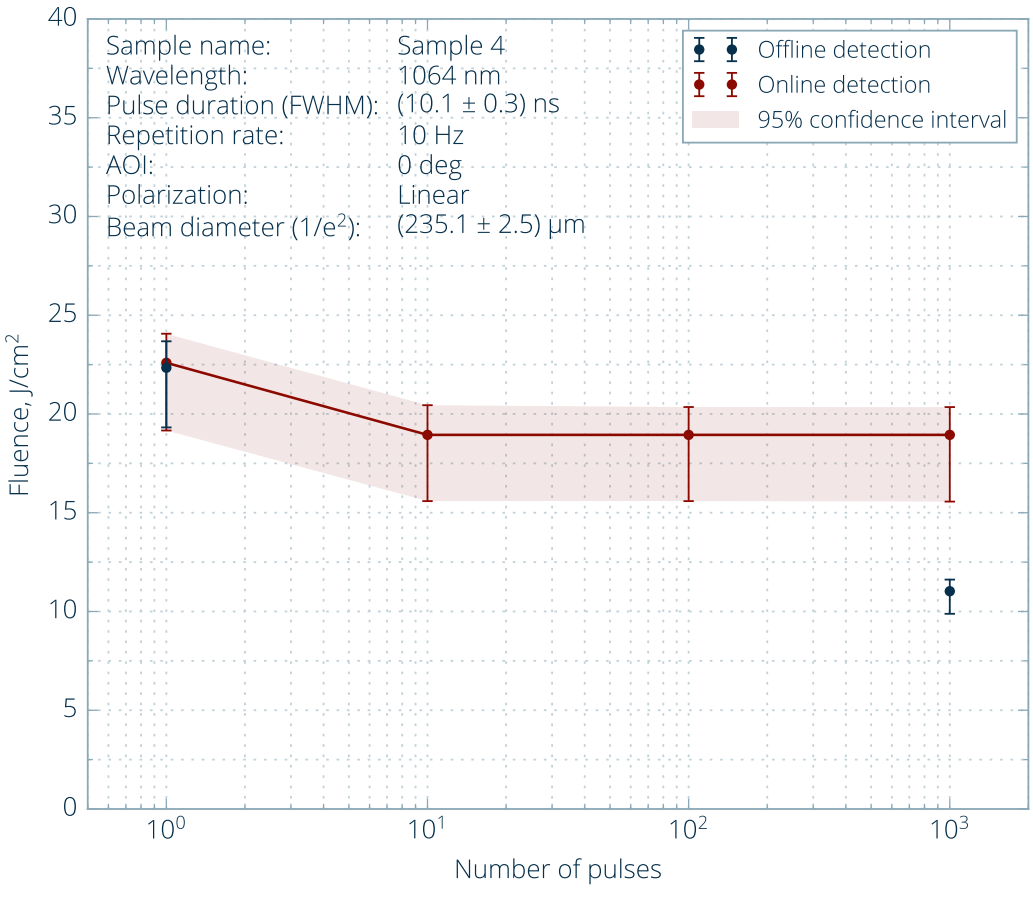
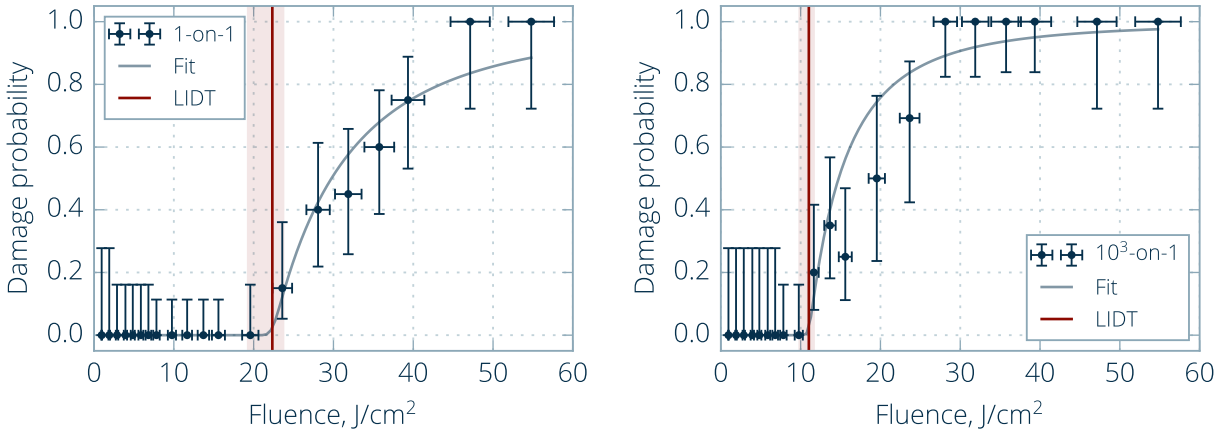


Figure 2. Characteristic damage curve.

DAMAGE PROBABILITY (OFFLINE DETECTION)



(a) 1-on-1

(b) 10^3-on-1

Figure 3. Damage probability plots.

TYPICAL DAMAGE MORPHOLOGY (OFFLINE DETECTION)

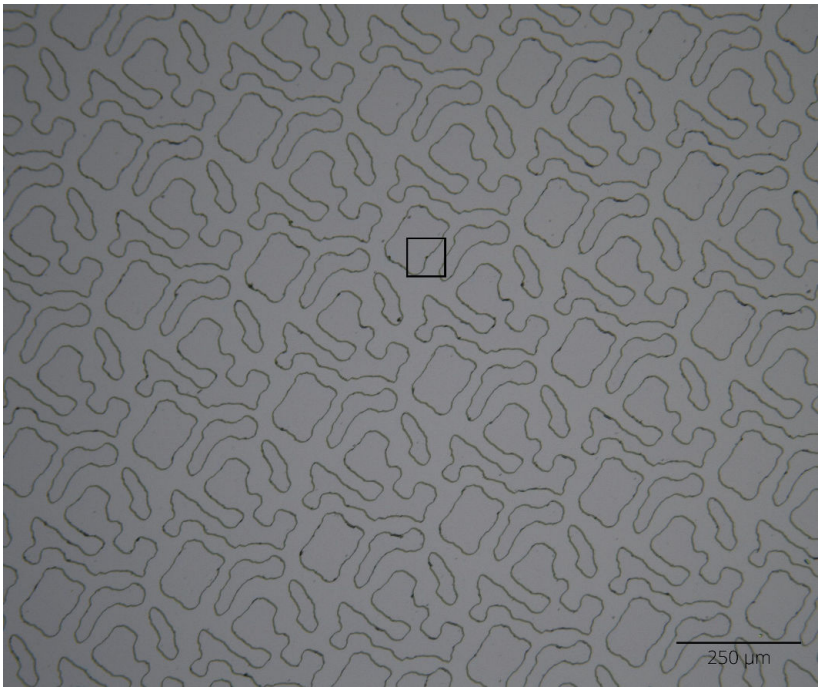


Figure 4. Typical damage morphology: fluence 13.7 J/cm^2, damage after 1000 pulse(s).

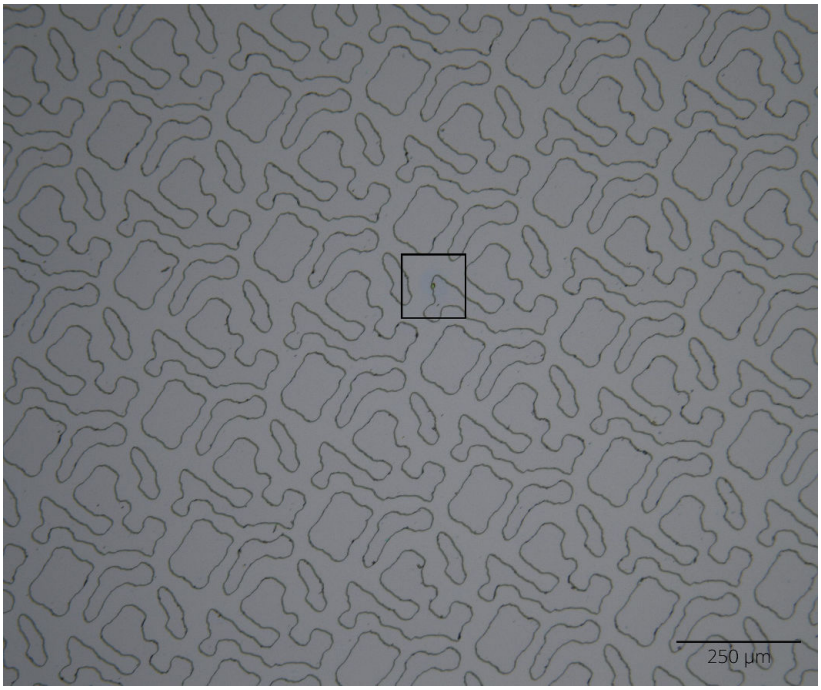
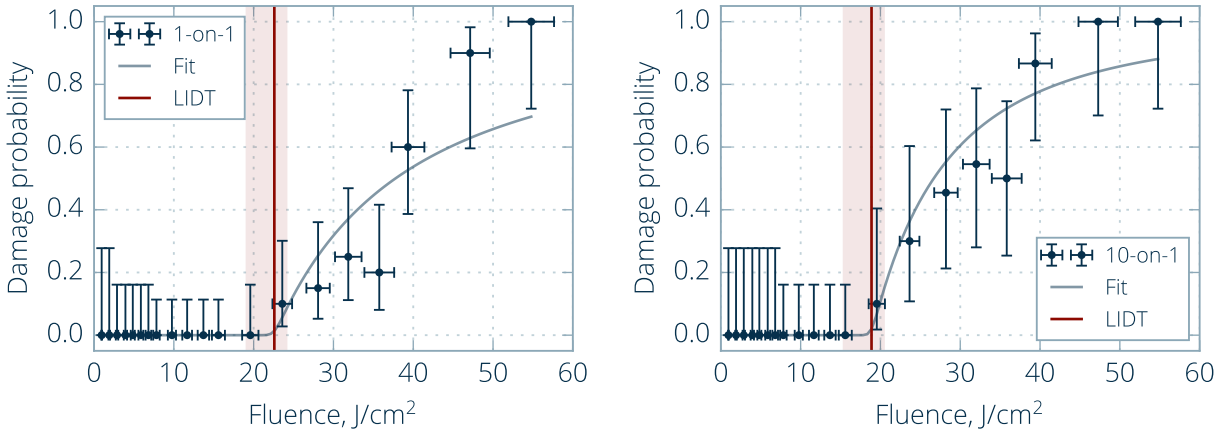


Figure 5. Typical damage morphology: fluence 28.2 J/cm^2, damage after 1000 pulse(s).

DAMAGE PROBABILITY (ONLINE DETECTION)



(a) 1-on-1

(b) 10-on-1

(c) 10^2-on-1

(d) 10^3-on-1

Figure 6. Damage probability plots.