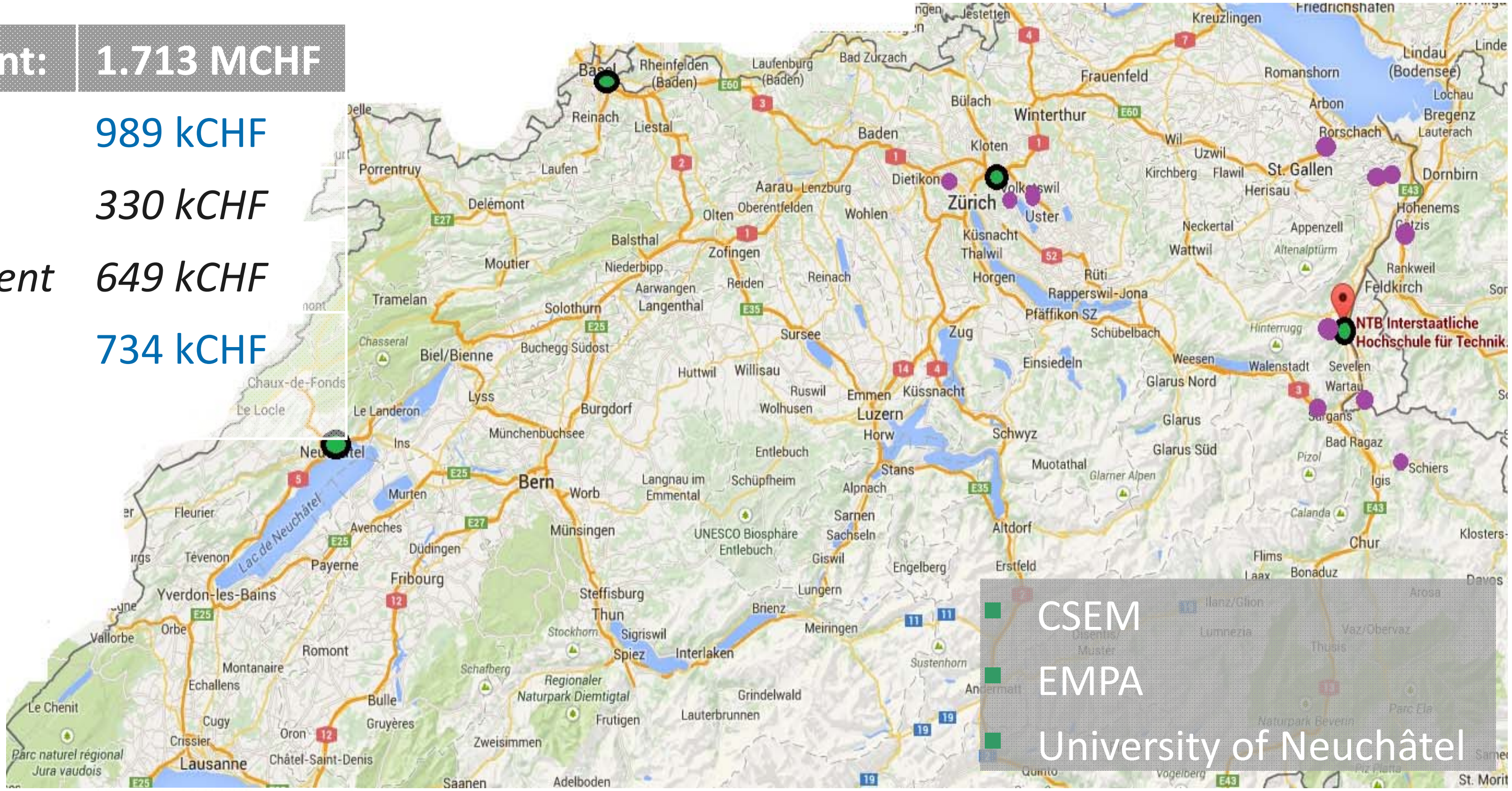
RhySearch
Das Forschungs- und Innovationszentrum Rheintal

NTB
Interstaatliche Hochschule für Technik Buchs
FHO Fachhochschule Ostschweiz

KTI-Project: LIDT and Degradation Testing for Industrial Applications

Total Investment:	1.713 MCHF
Industry:	989 kCHF
Personel	*330 kCHF*
Misc./Equipment	*649 kCHF*
Research:	734 kCHF
Personel	



vectronix
TRUMPF
swissoptic
onefive
Montfort Laser GmbH
evatec process systems
FILTROP AG
FISBA OPTIK
GMP GENERAL MICROTECHNOLOGY & PHOTONICS
IMT PRECISION ON GLASS

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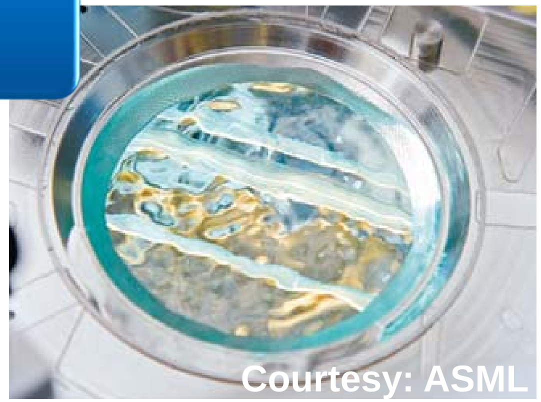
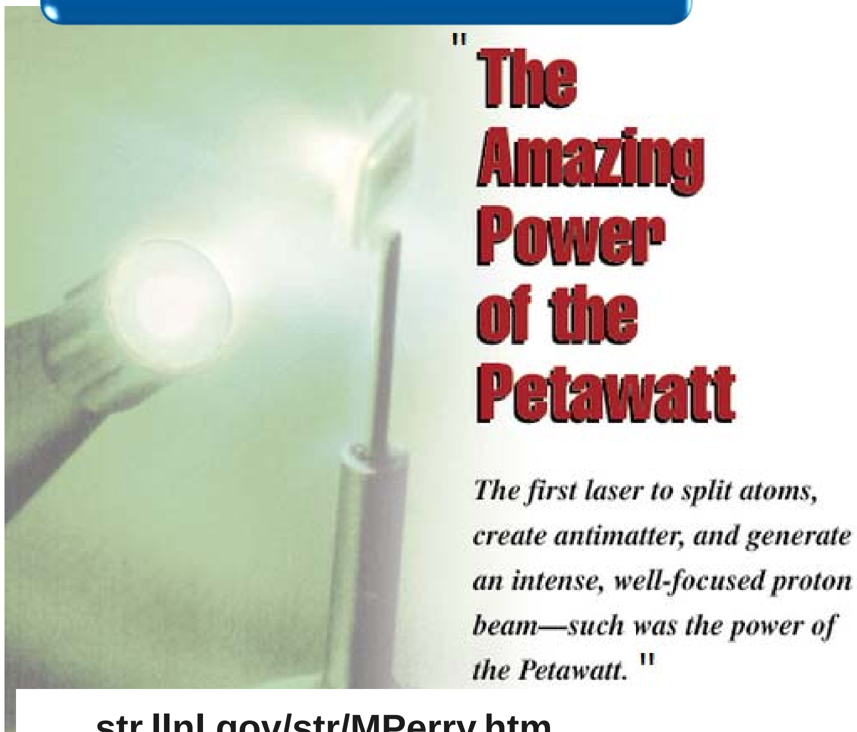
Some High-Power Coatings Applications

Deep and Extreme UV Lithography



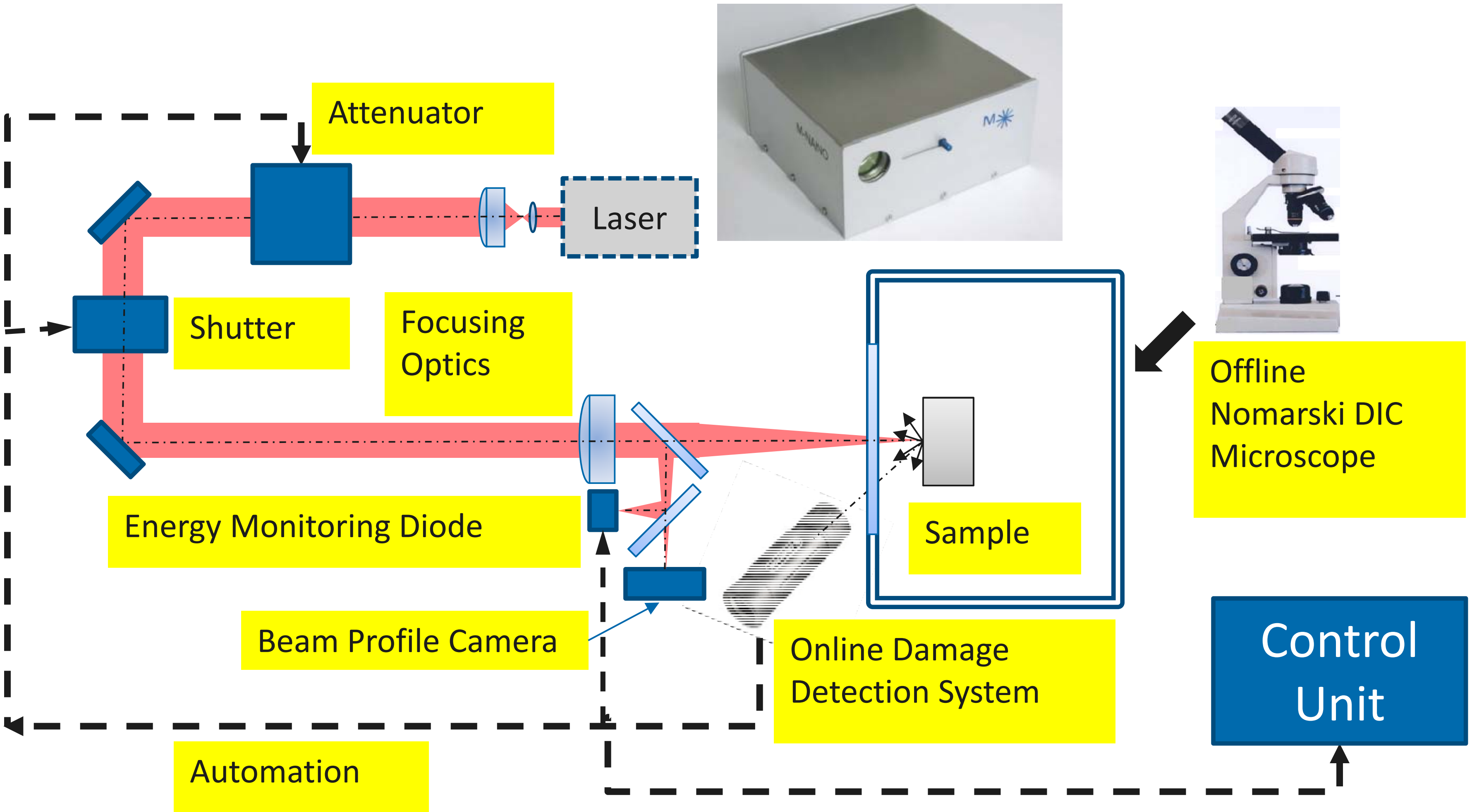
High-Energy Petawatt Lasers



str.llnl.gov/str/MPerry.htm

Space Applications

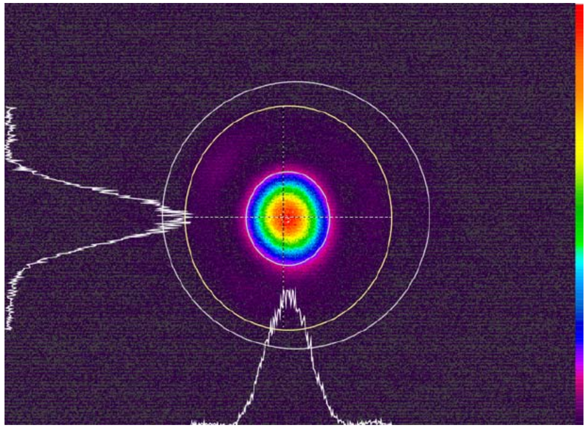
The RhySearch LIDT Testing Facility at the NTB Buchs

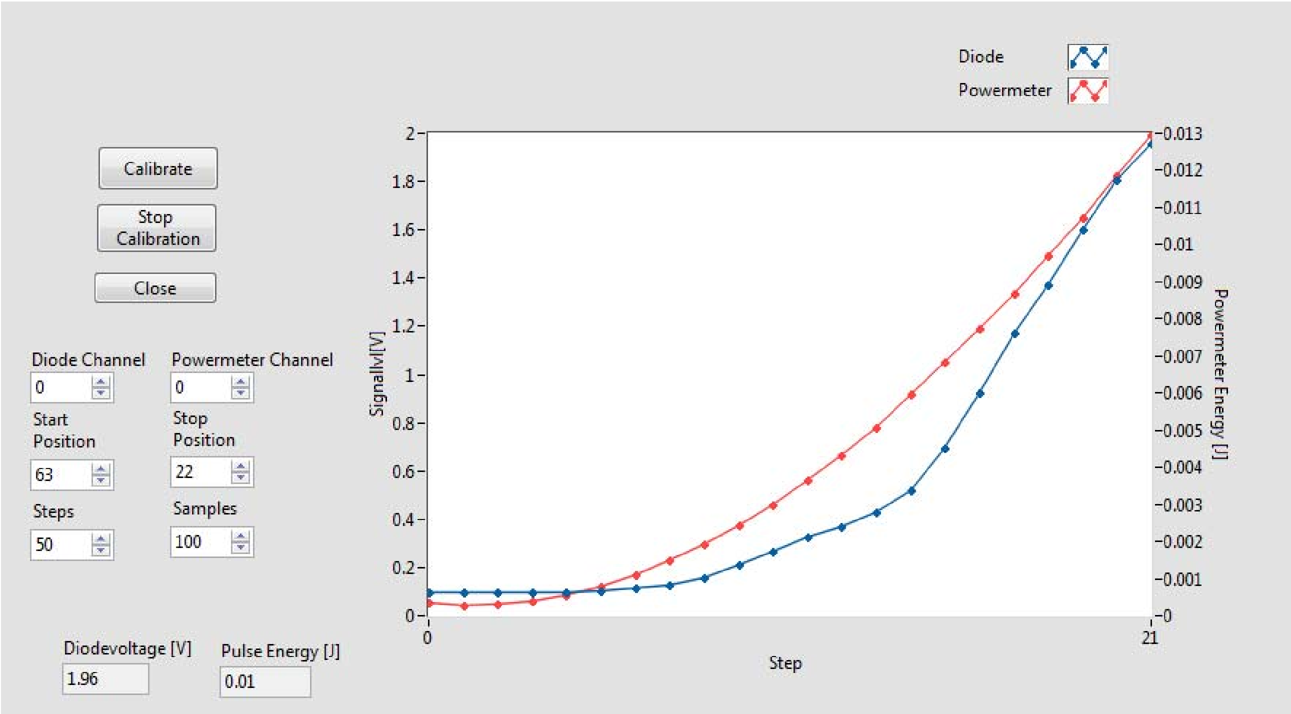


- *Measurement according to ISO Norm 21254 (1 - 4)*

An LIDT Measurement Process: S-on-1

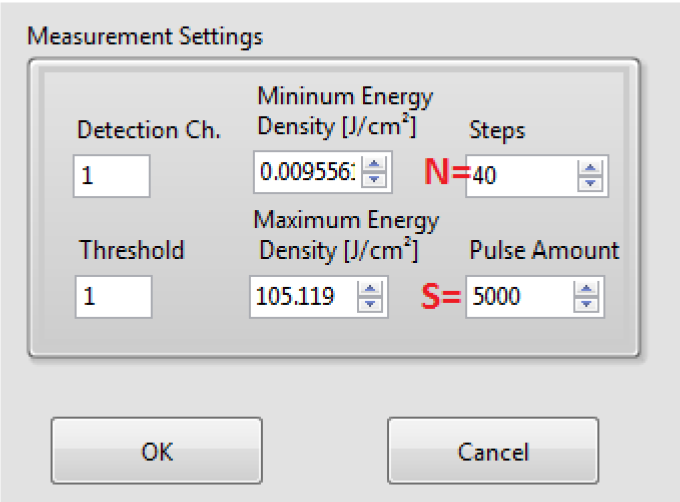
- **Measurement of the Laserparameters: Diameter, Profile, Pulse duration**
- **Powermeter/Energydiode calibration**

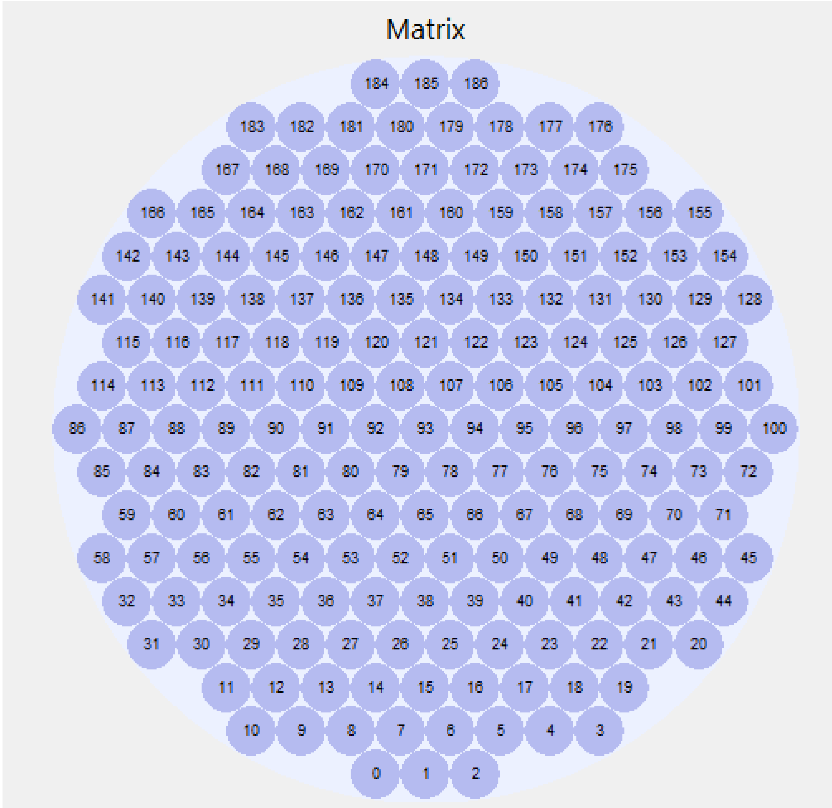




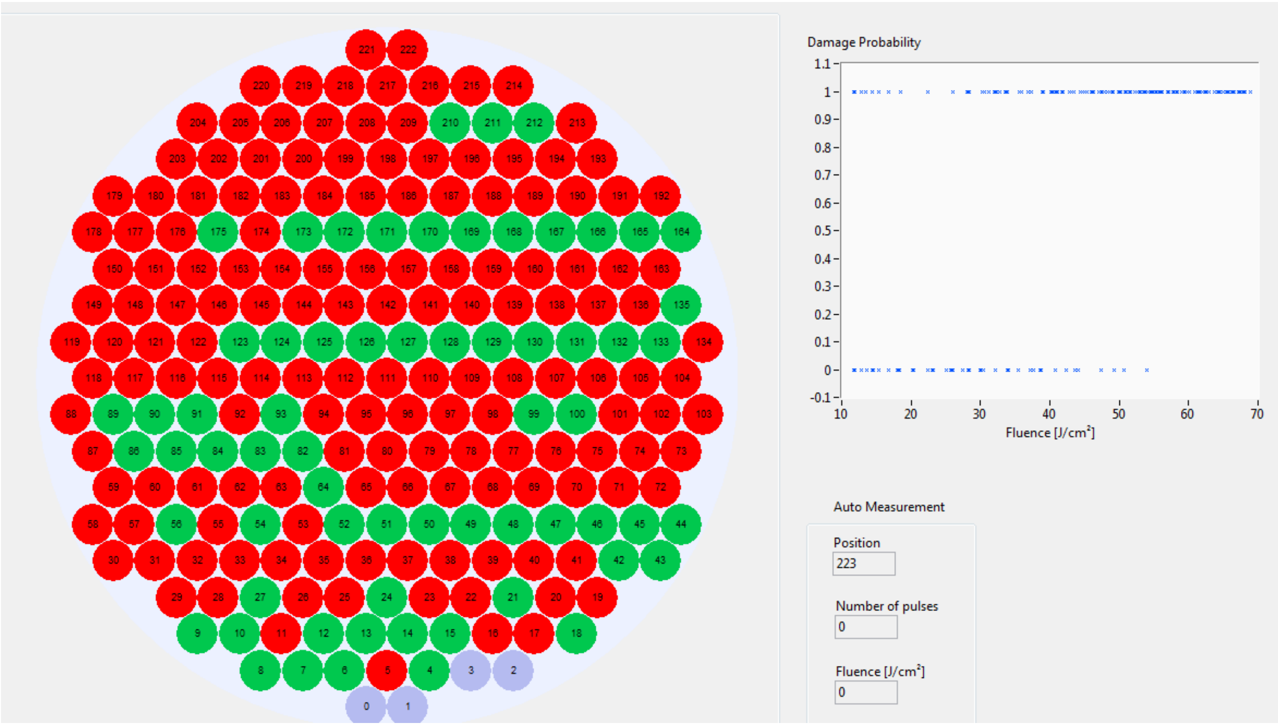
An LIDT Measurement Process: S-on-1

- Measurement of the Laserparameters: Diameter, Profile, Pulse duration
- Powermeter/Energydiode calibration
- **Define laser fluence range of interest**
- **Define the fluence steps to be used (N)**
- **Divide substrate into a matrix of sites**





An LIDT Measurement Process: S-on-1



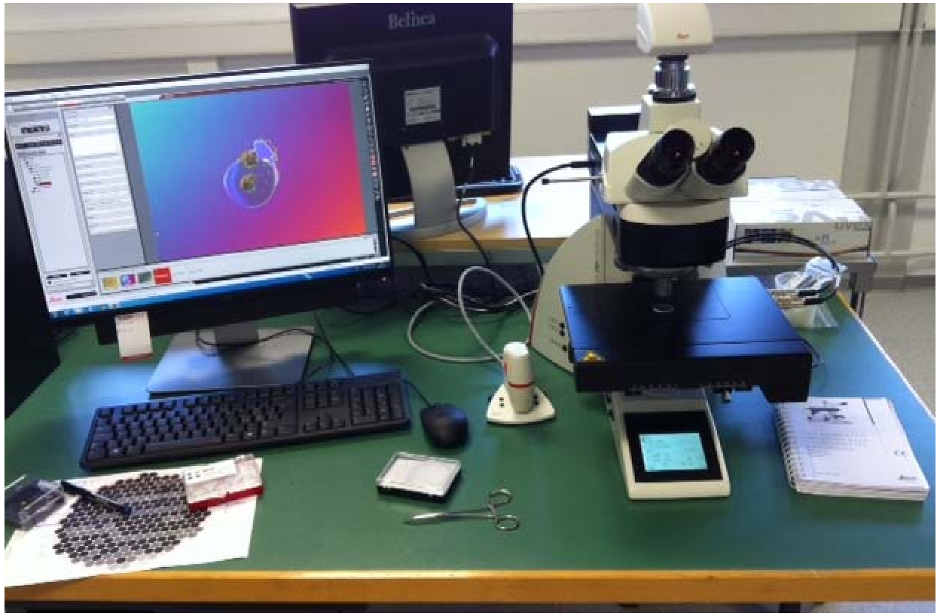
- Each site is irradiated with S Pulses at a specific fluence

  → if no damage occurs, irradiate next site (increased laser fluence)

  → If damage occurs before S Pulses, log information and irradiate next site

Each fluence-increment is used several times → Increased statistics

An LIDT Measurement Process: S-on-1



- Measurement of the Laserparameters
- Powermeter/Energydiode calibration
- Define laser fluence range of interest
- Define the fluence steps to be used
- Divide substrate into a matrix of sites

- Each site is irradiated with S Pulses

  → if no damage occurs, irradiate next site (increased laser fluence)

  → If damage occurs before S Pulses, log information and irradiate next site

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- **Post LIDT Testing damage verification using a Nomarski DIC Microscope (100x)**

  → Deviations are incorporated into the measured results

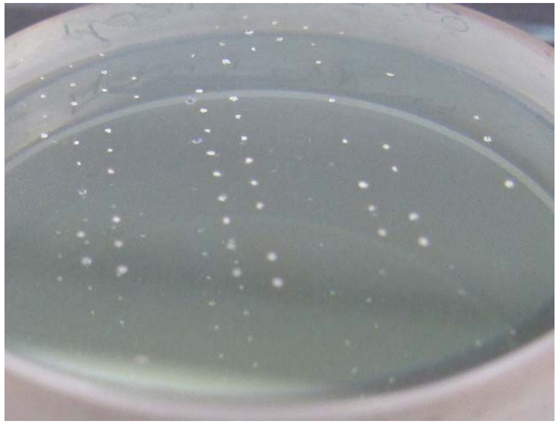
Example of an LIDT Test: Double Sided AR Coating

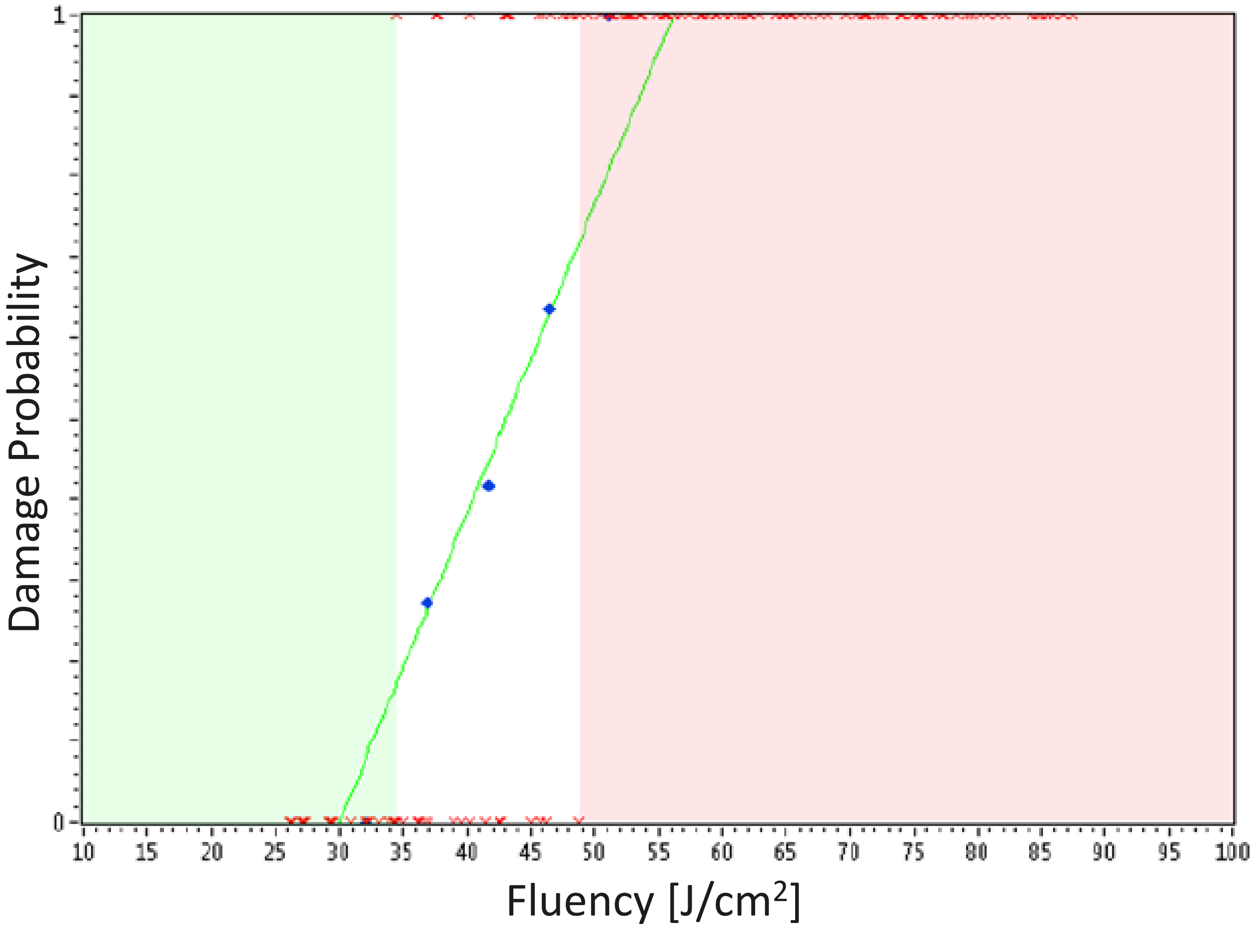
- Test procedure: 5000-on-1
- Number of matrix sites: 150
- Beam diameter:
  190 µm ± 10µm

0% LIDT: 31.6 J/cm^2

50% LIDT: 40.7 J/cm^2

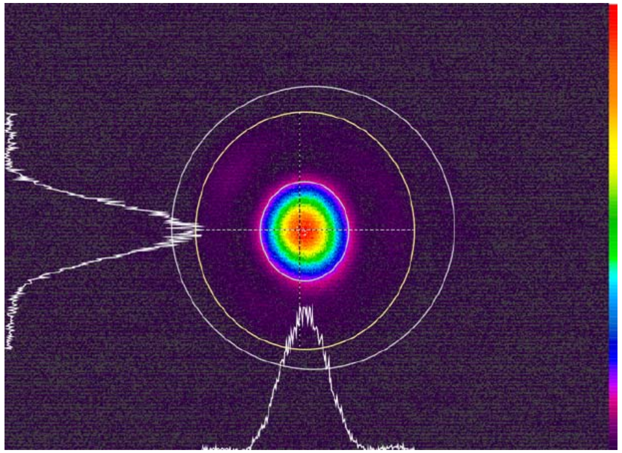
Fluence-Error: σ = 11.5%





Measurement Factors Influencing the LIDT of a Sample:

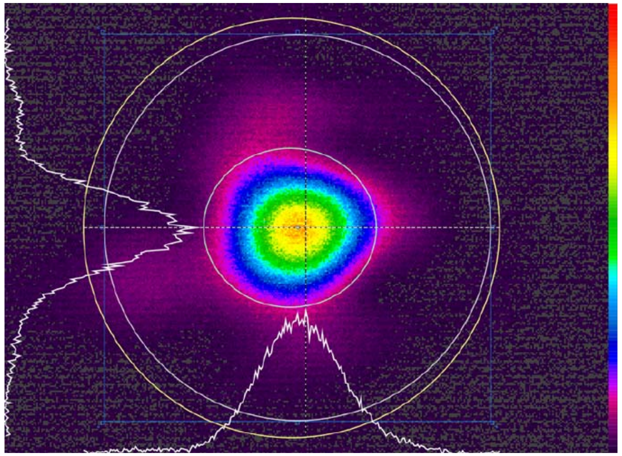
1. Measurement wavelength
2. Pulse duration
3. Pulse repetition frequency
4. Beam diameter and shape
5. Angle of Incidence



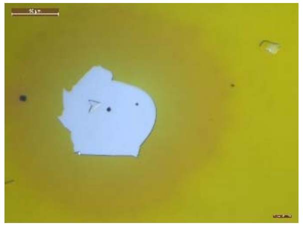
Next Steps:

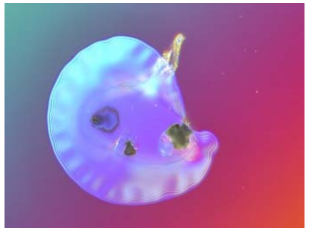
1. Montfort M-Nano Laser extension to 532nm, 355nm
2. Adding a OneFive fs-Laser
3. Incorporation of Degradation Testing

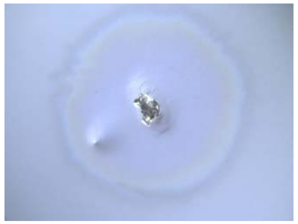
LIDT Certification for Lifetime Testing

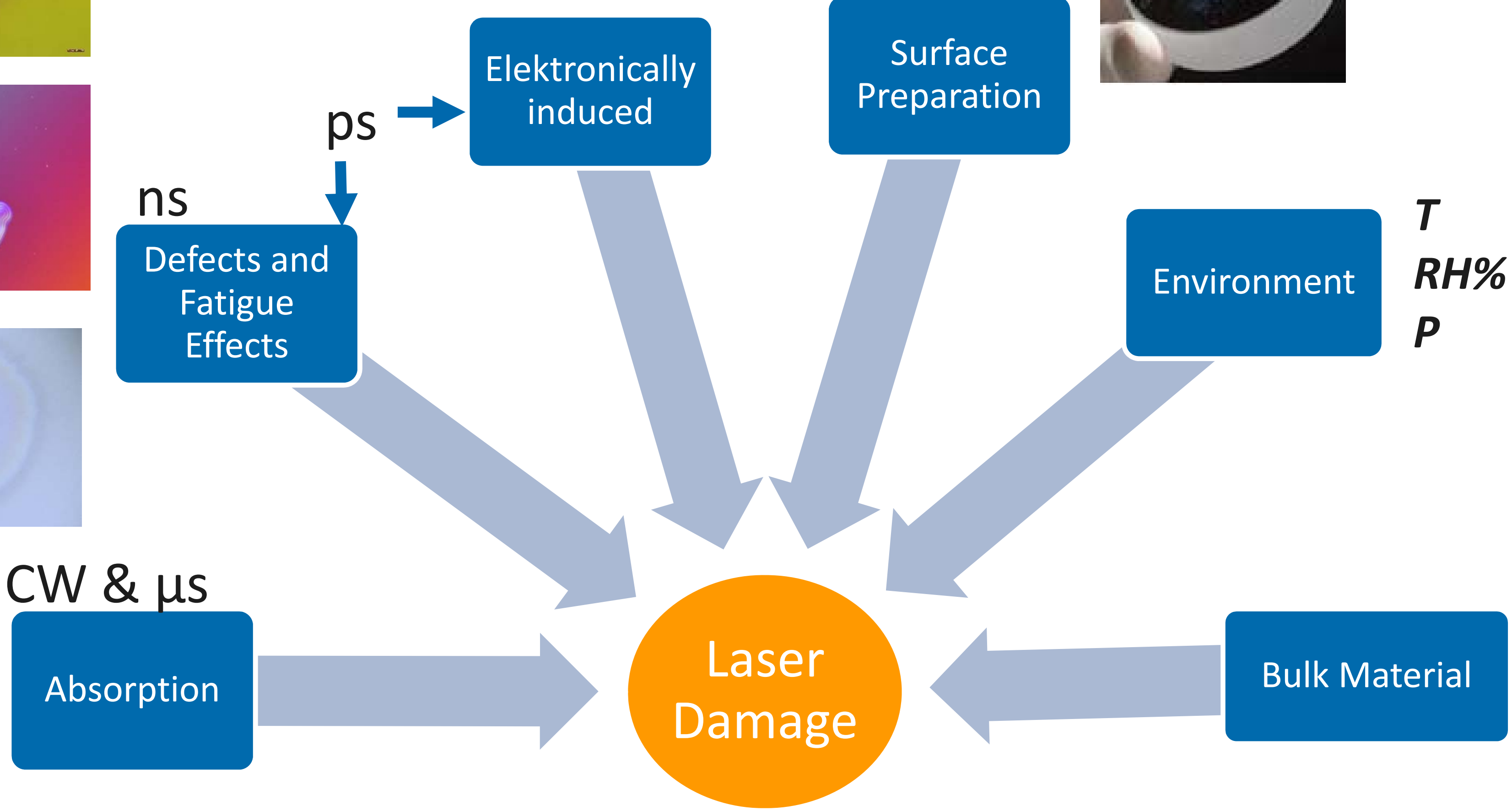


What Substrate and Coating Variables Cause Laser Damage?









Präparation/Untersuchung

- Proben wurden mit Kohlenstoff bedampft in einem Leica ACE 200 – Bedampfer. Die angestrebte Schichtdicke beträgt d = 40 nm
- Die Proben wurden anschliessend im FIB/REM-System des Typs FEI Helios 660 G3 UC untersucht.
- Zum Schutz der Oberfläche wurde jeweils mittels elektroneninduzierter Deposition eine ca. 300 nm dicke Schutzschicht aus Platin aufgetragen, um die Oberfläche am Ort des Schnittes vor der Schädigung durch den Ionenstrahl zu schützen. Mit dem gleichen Ziel wurde mittels ioneninduzierter Abscheidung eine Platin oder Wolfram-Schicht mit einer Dicke von ca. 1 um aufgetragen.

SEM-Untersuchung: Übersicht Beschusskrater

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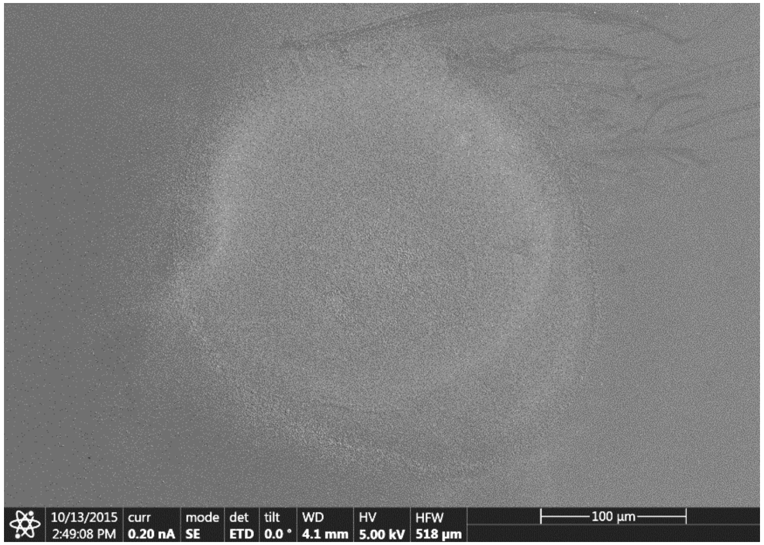
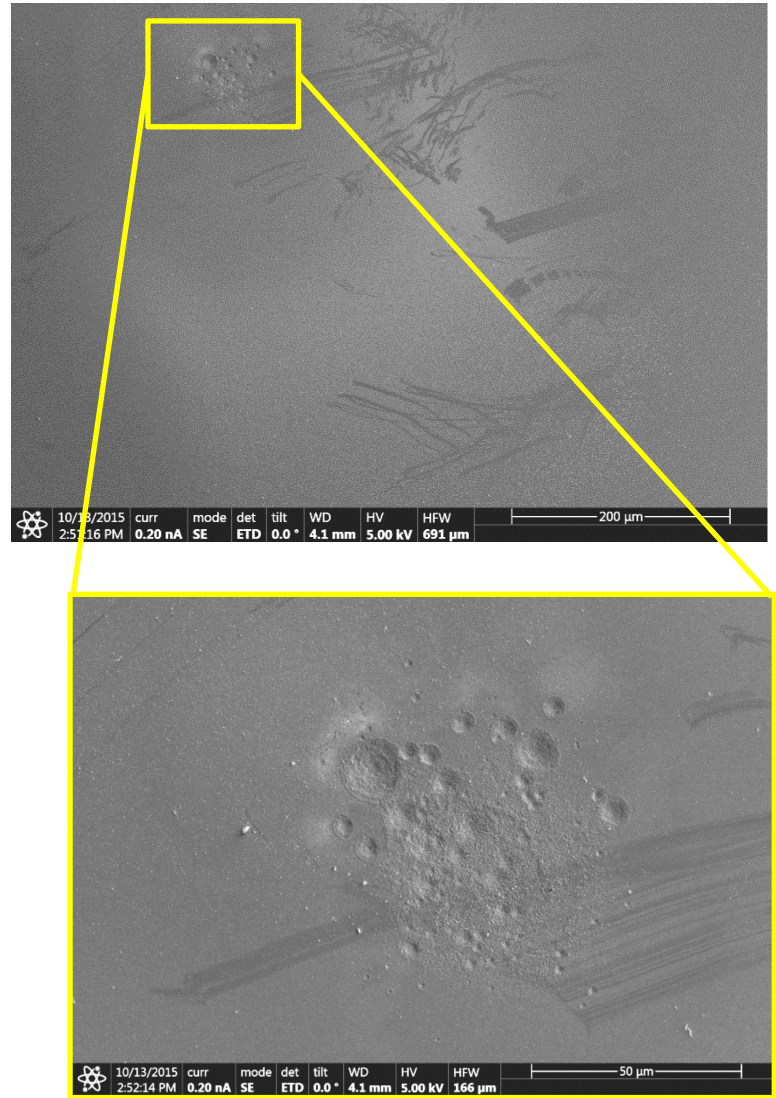
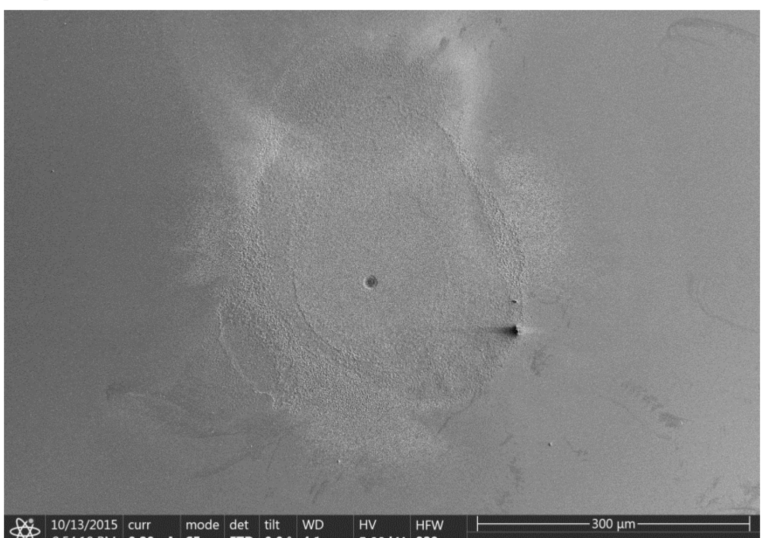
Spot 1



Spot 2



Spot 3



SEM/FIB-Untersuchung: Spot 3

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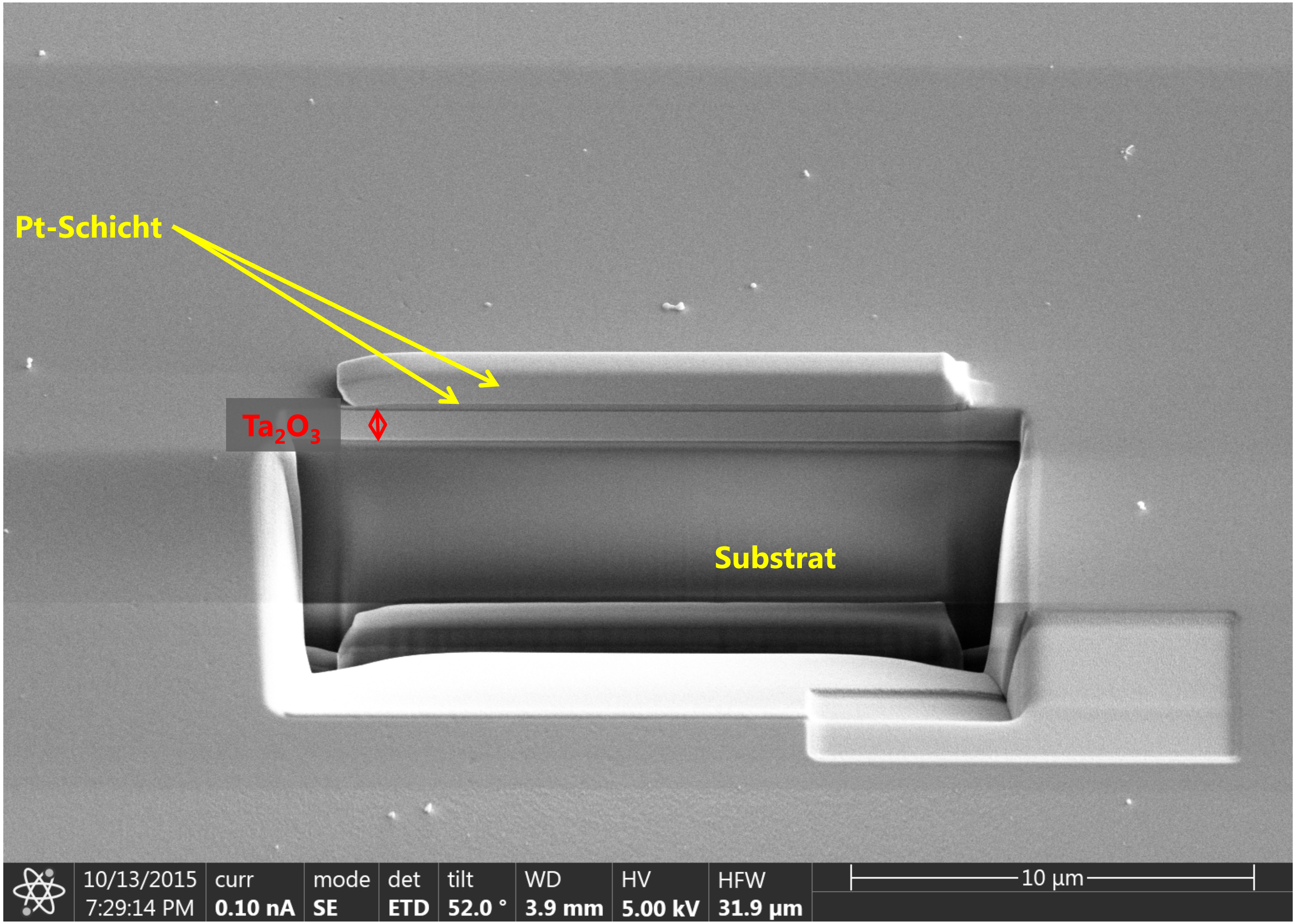
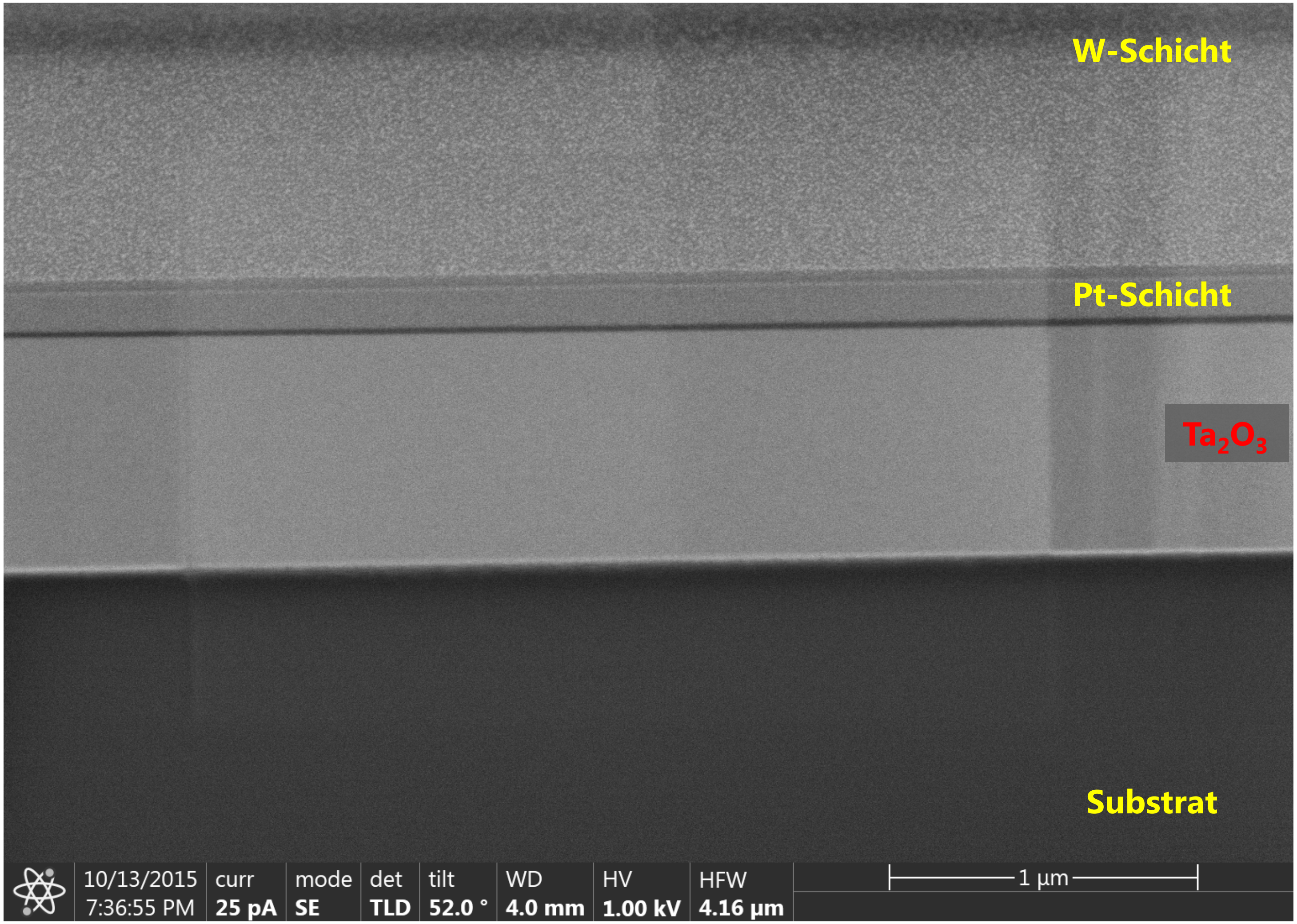
CS2 – Ausserhalb des Beschusskraters:

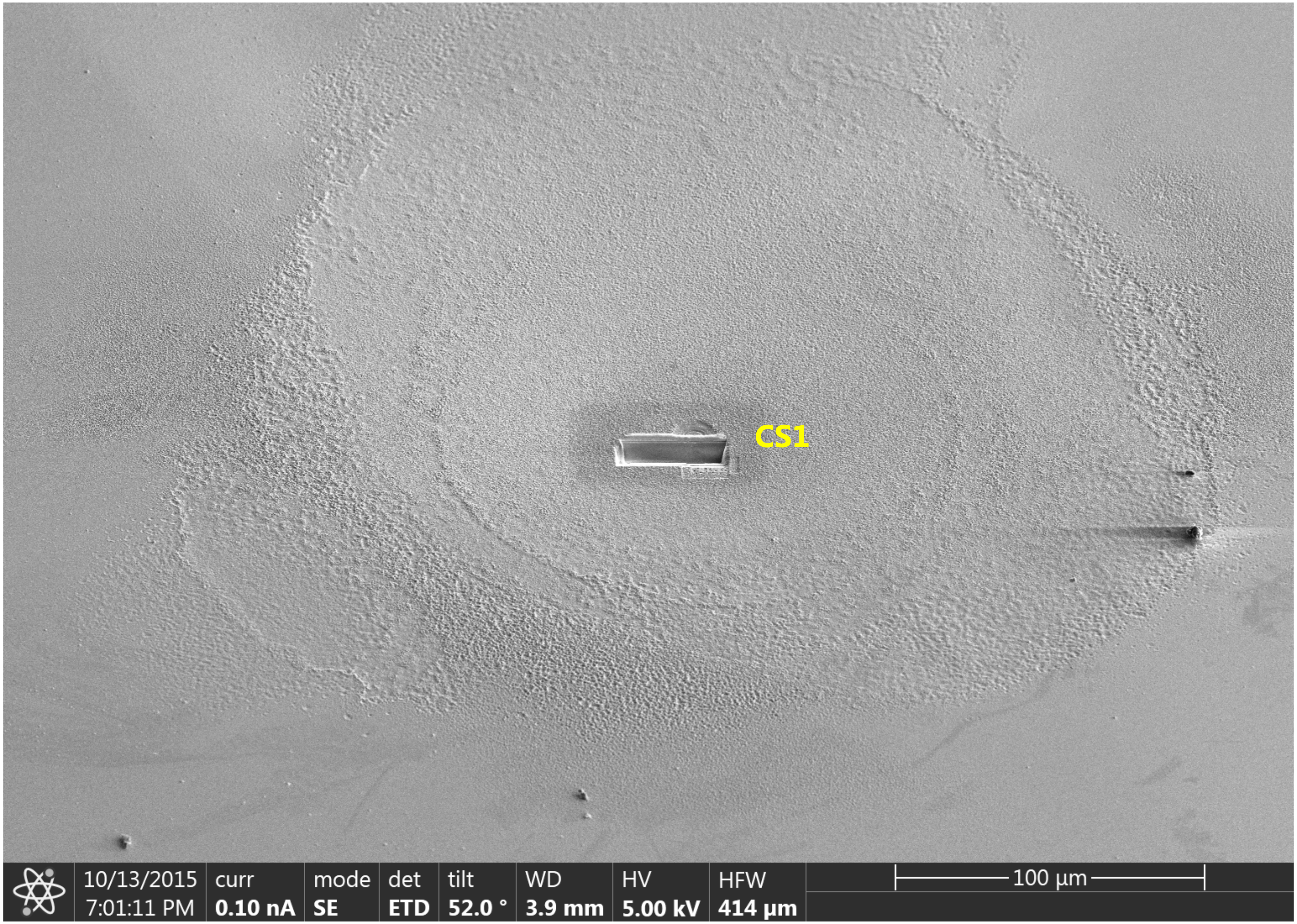


SEM/FIB-Untersuchung: Spot 3

CS2 – Ausserhalb des Beschusskraters: Schichtdicke: d≈940 nm



SEM/FIB-Untersuchung: Spot 3



SEM/FIB-Untersuchung: Spot 3

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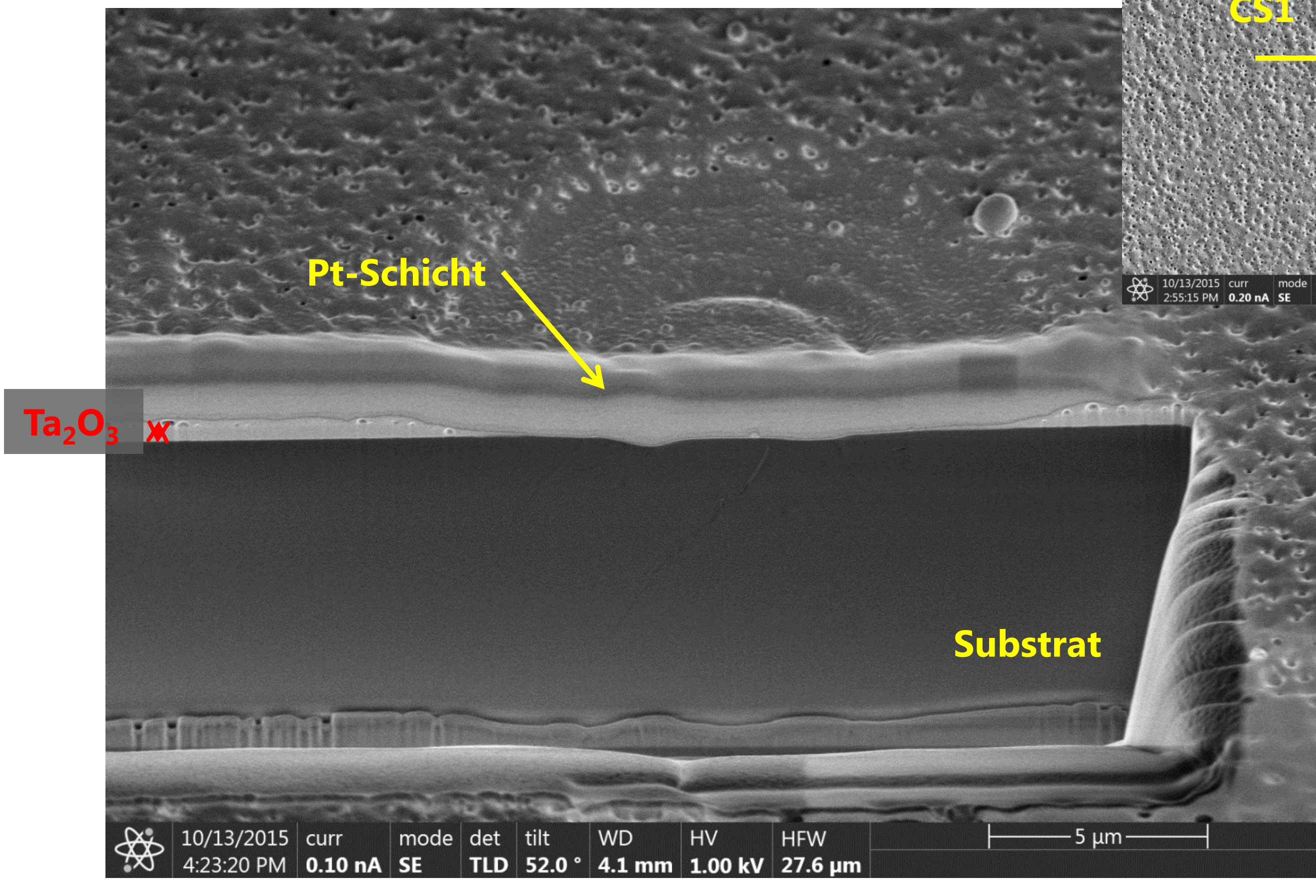
CS1 – Zentrum des Beschusses:



SEM/FIB-Untersuchung: Spot 3

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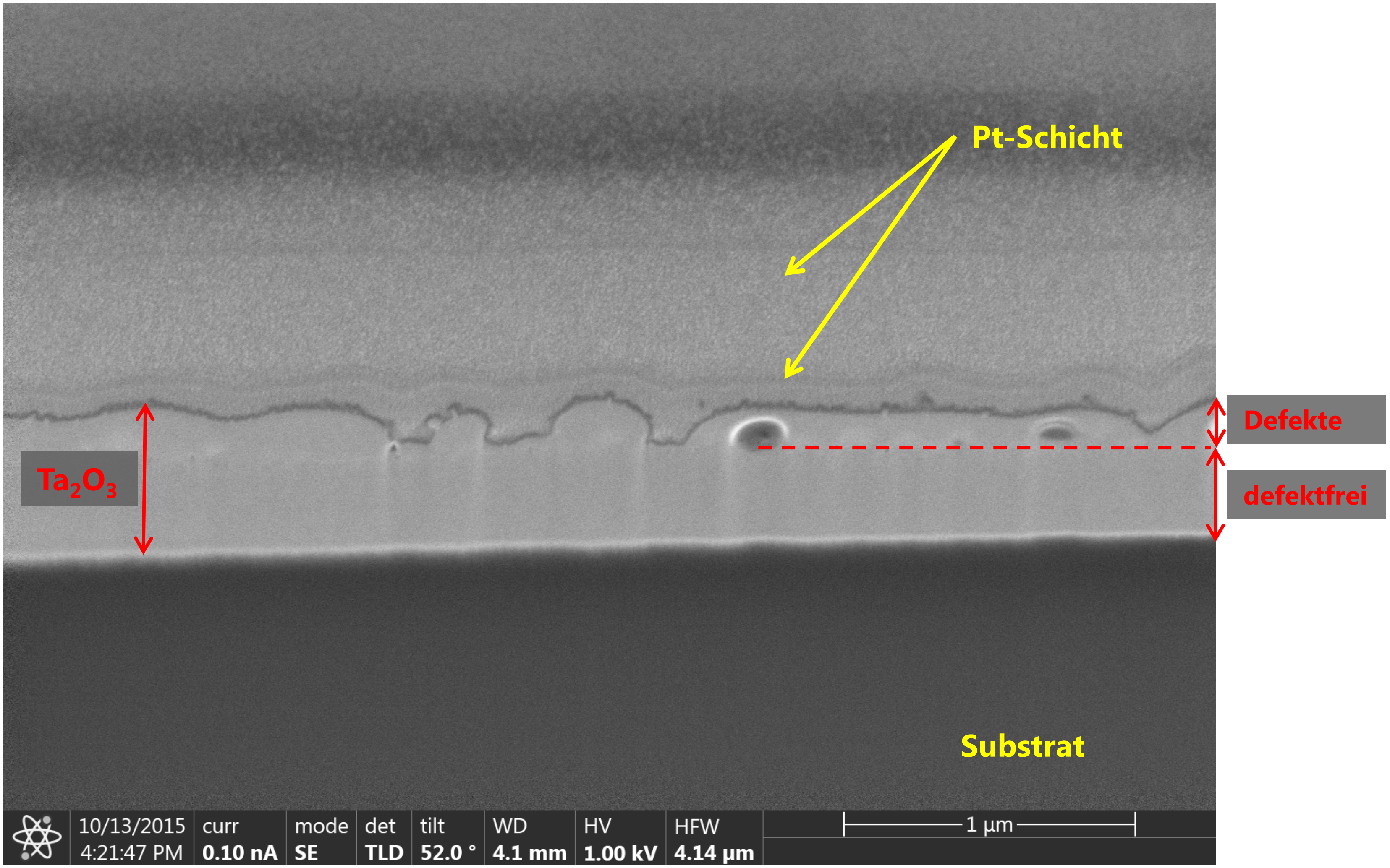
CS1 – Zentrum des Beschusses: Schichtdicke d≈440-650 nm



SEM/FIB-Untersuchung: Spot 3

CS1 – Zentrum des Beschusses: