



## 2. NOVALIS Meeting – Update BUW

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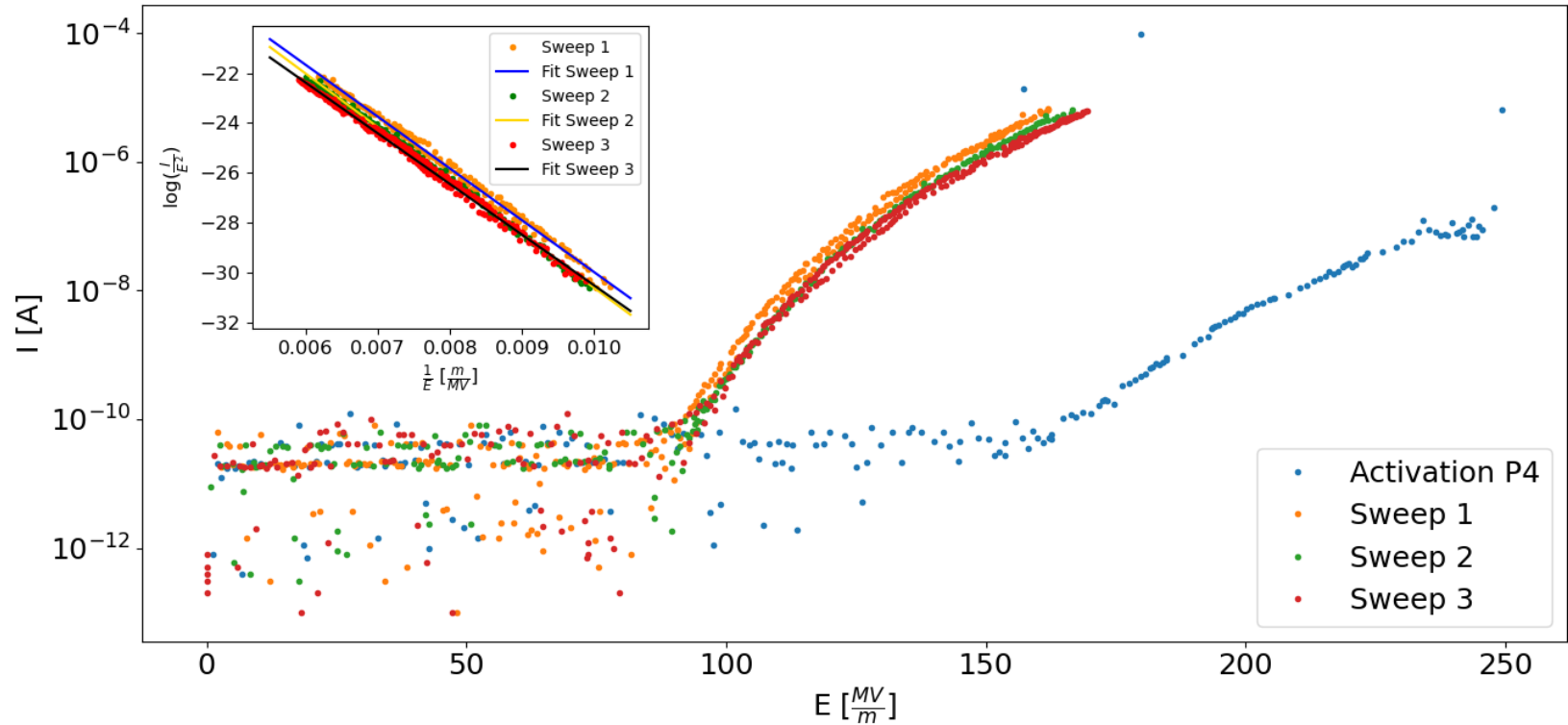
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- Current state
  - Power supply is back and installed again
  - Measurements on single spots are possible
    - Activation curves
    - Emission curves
- Planned for the future
  - Overhaul Software
  - Implementing mapping of areas
    - Constant current
    - Constant voltage

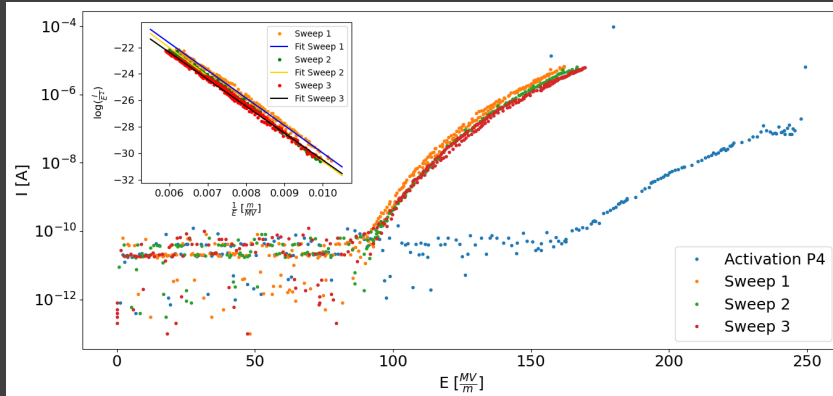
## Measurements on NbTiN-Films

- Samples prepared by Isabel
- Film thickness: 60 nm NbTiN on 20 nm AlN
- Two types of samples
  - As-deposited
  - Annealed
- FESM measurements on several spots
  - Activation curves
  - Emission curves on activated surfaces
- SEM images of the surface after activation

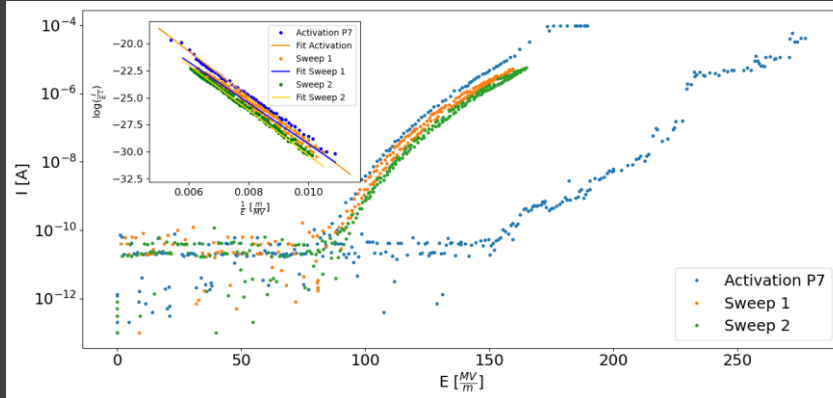
## FESM measurements on NbTiN-Films: Results Sample 1 (Annealed)



## FESM measurements on NbTiN-Films: Results Sample 1 (Annealed)



- Onset field for field emission at 182 MV/m
- Full activation of the surface at 250 MV/m
- After activation surface follows Fowler-Nordheim-Theory of field emitters



- Onset field for field emission at 168 MV/m
- Full activation of the surface at 277 MV/m
- After activation surface follows Fowler-Nordheim-Theory of field emitters

## FESM measurements on NbTiN-Films: Results Sample 1 (Annealed)

Fitting the data yields fluctuating fit parameters

- Unknown work function leads to large errors
- Different spots yield different parameters with partly strong deviation from each other

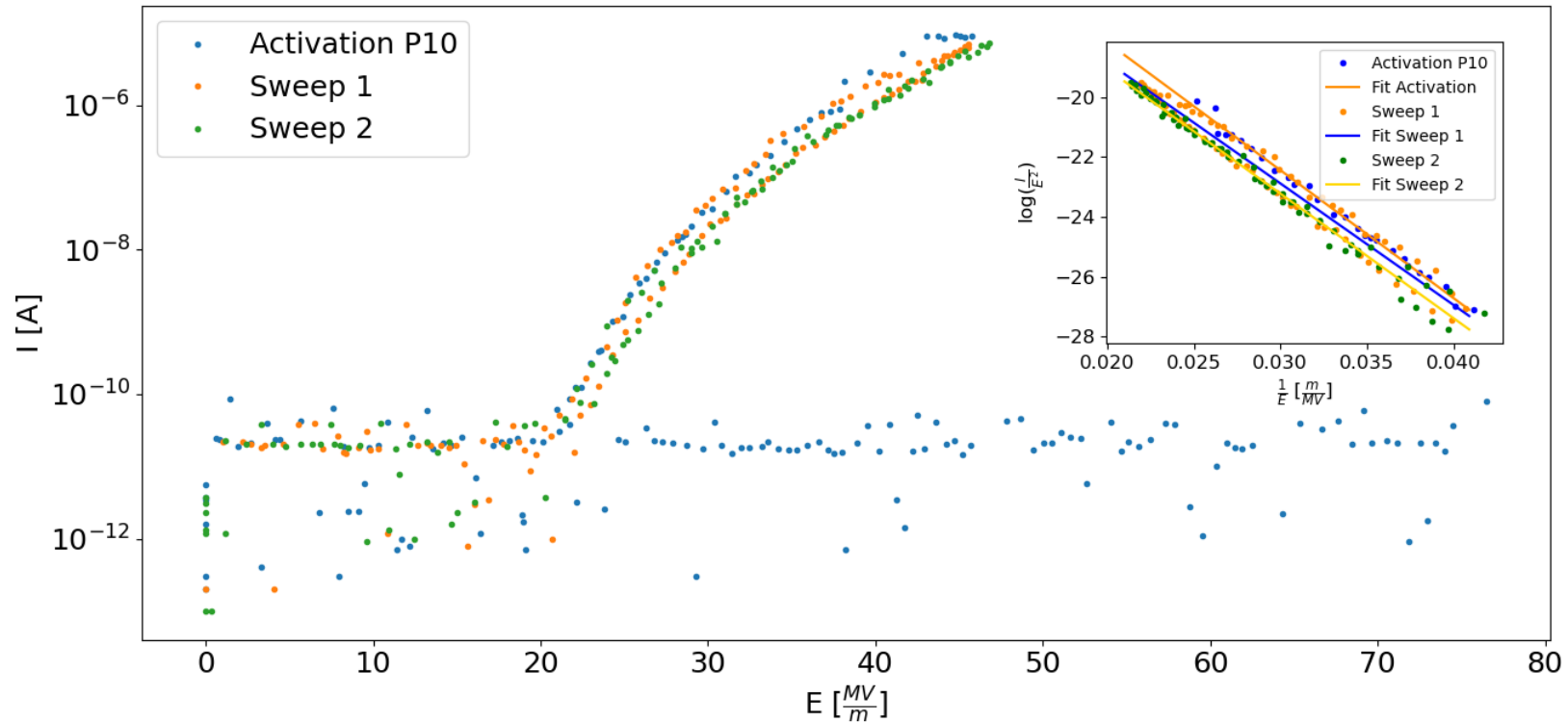
Fitparameter for P4:

- Working function  $\phi$ : 2.79 eV
- Geometry factor of the tip  $\beta$ : 35.4
- Effective emission area  $S$ :  $1.1 \times 10^{-18} \text{ m}^2$

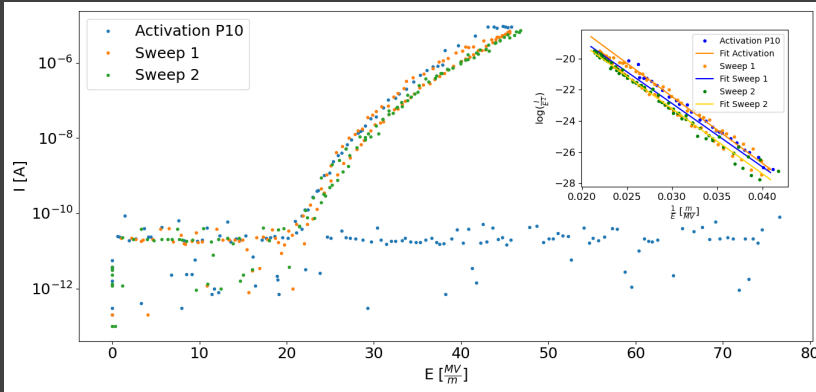
Fitparameter for P7:

- Working function  $\phi$ : 3.10 eV
- Geometry factor of the tip  $\beta$ : 52.09
- Effective emission area  $S$ :  $4.8 \times 10^{-19} \text{ m}^2$

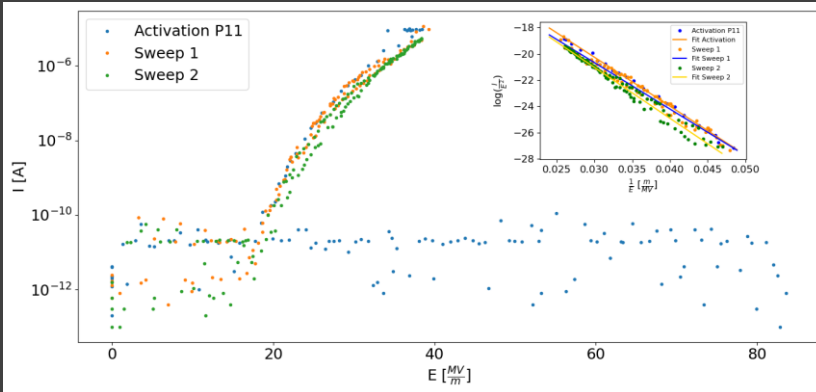
## FESM measurements on NbTiN-Films: Results Sample 2 (As-Deposited)



## FESM measurements on NbTiN-Films: Results Sample 2 (As-Deposited)



- Full activation of the surface at 76 MV/m
- $\phi$ : 2.39 eV
- $\beta$ : 112.39
- $S$ :  $4.28 \times 10^{-15} \text{ m}^2$



- Full activation of the surface at 83 MV/m
- $\phi$ : 2.42 eV
- $\beta$ : 131.45
- $S$ :  $7.14 \times 10^{-20} \text{ m}^2$

## FESM measurements on NbTiN-Films: Annealed vs As-Deposited

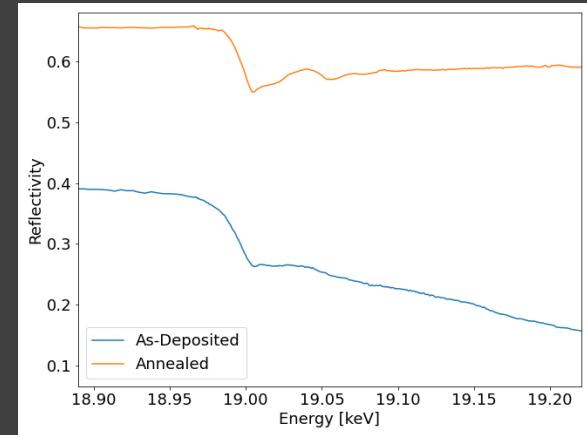
Annealing the samples leads to structural changes according to grazing incidence EXAFS measurements. Accordingly, an increase of the activation threshold for field emission was found

### Annealed

Spot	Full Activation [MV/m]
2	158
3	402
4	249
6	308
7	277
8	296
9	277
Average	281

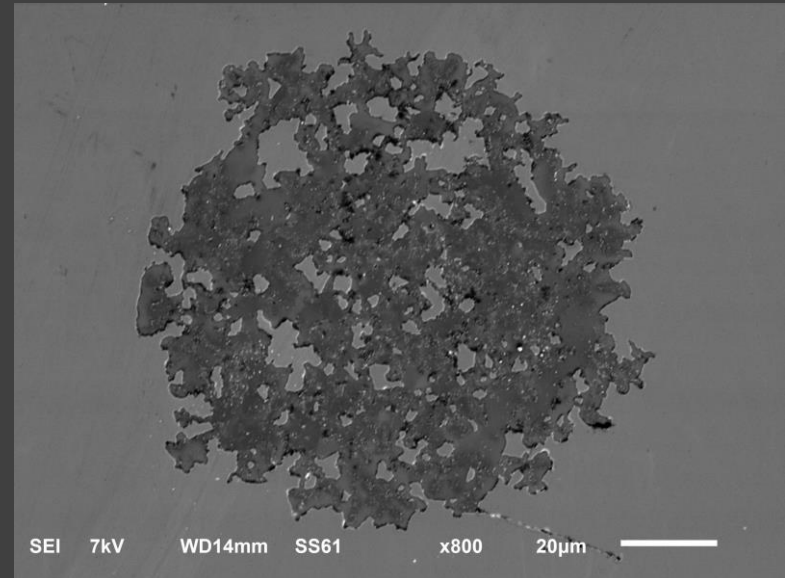
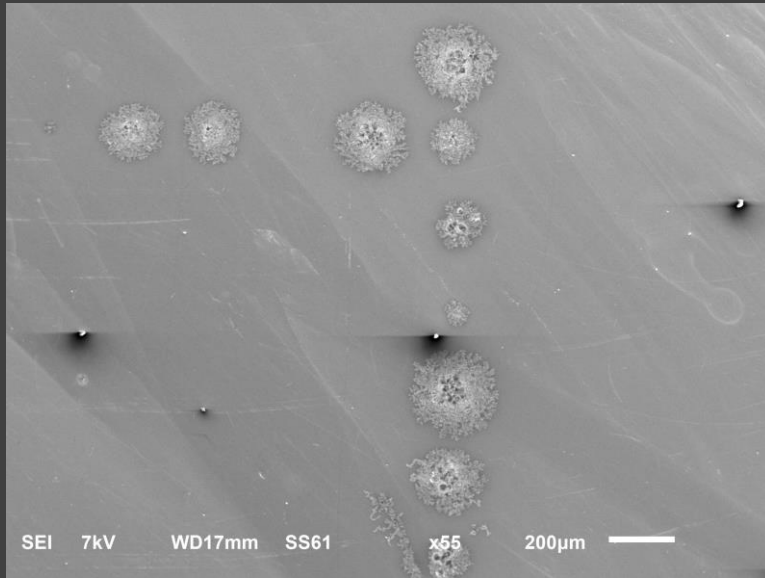
### As-Deposited

Spot	Full Activation [MV/m]
3	109
4	125
5	86
6	119
9	94
10	76
11	83
12	71
Average	95



Grazing incidence  
EXAFS at Nb-K-Edge

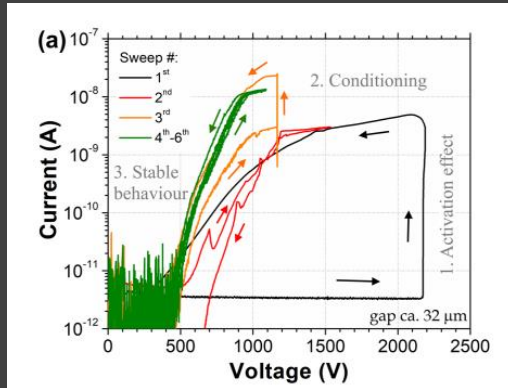
## SEM measurements on NbTiN-Films



Activation of the sample destroys the film coating locally

## FESM: What can be done differently?

- Testing the long term stability of the samples under a certain well-defined tunnel current
  - Investigate if current rises over time
  - Is a full activation with this method possible?
- Testing the reproducibility of the current development before the full activation
- Limiting the max. current with resistors instead of using the power supply
  - Power supply regulates current too slow → Surface gets damaged



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Thank you for your  
Attention