Universität Hamburg
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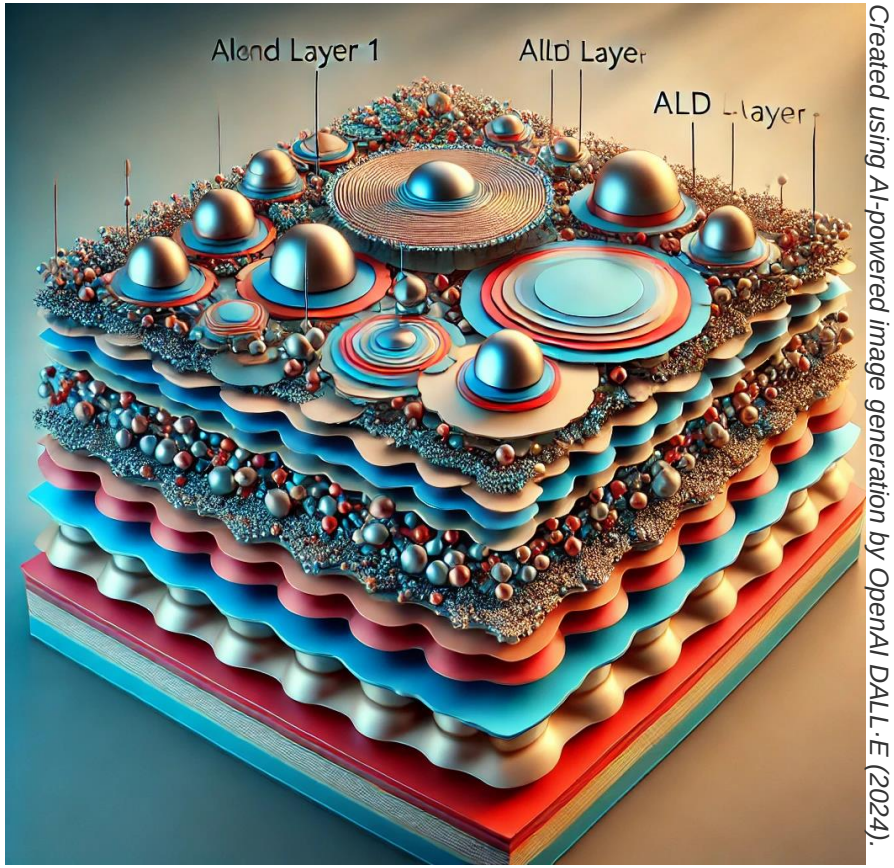
Credit: T. Stengler, JCU & Midjourney AI

# Superconducting and sustainable RF for improved Accelerator Efficiency

## *SuperSurface*




*Created using AI-powered image generation by OpenAI DALL·E (2024).*

16.06.2025 **Marc Wenskat – on behalf of L. Preece, A. Zaidman, W. Hillert**

# What is our plan?

- Three Workpackages
  - WPA: Coating copper with high $T_c$ superconductors / multilayers for 4K operation
    - 1PhD – Lea Preece
  - WPB: Plasma Electropolishing
    - Collaboration with Chemnitz
  - WPC: Disordered Superconductor
    - 1 PhD – Artem Zaidman @ Nanolab

TECHNISCHE UNIVERSITÄT CHEMNITZ

# Milestones

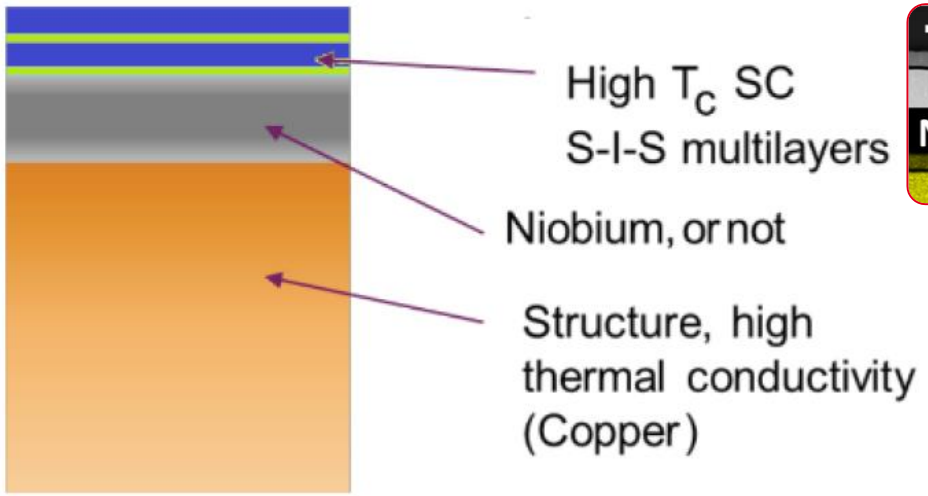
| No. | WP | Date (Quarter / Year) | Description of milestone |
|---|---|---|---|
| 1 | B.1 | I / 2025 | Flat samples / cut-outs provided to TU Chemnitz |
| 2 | C.3 | I / 2025 | First in-situ grain measurements finished |
| 3 | B.1 | II / 2025 | First Cu-QPR samples provided to TU Chemnitz |
| 4 | A.1 | II / 2025 | Fabrication of Cu-QPR samples finished |
| 5 | C.3 | II / 2025 | First in-situ MOKE measurements finished |
| 6 | A.5 | III /2025 | First NbTiN-coated antenna ready for assembly |
| 7 | C.2 | IV / 2025 | RF characterization of coated QPR samples by TUDA finished |
| 8 | C.2/B.1 | IV / 2025 | First PEP Nb-QPR sample measured |
| ~~9~~ | ~~B.2~~ | ~~IV / 2025~~ | ~~Dip-PEP set-up design finished~~ |

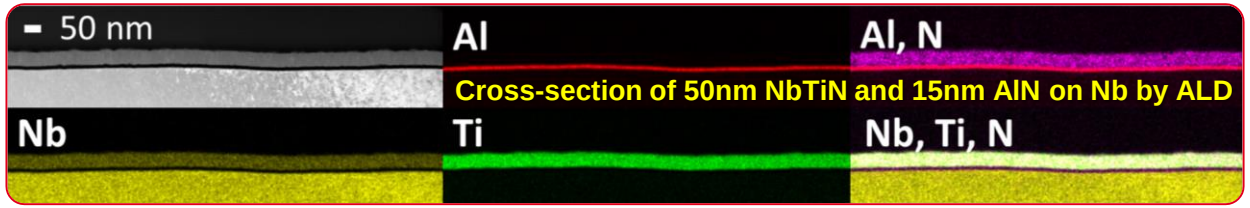
Focused on PEALD system so far – next

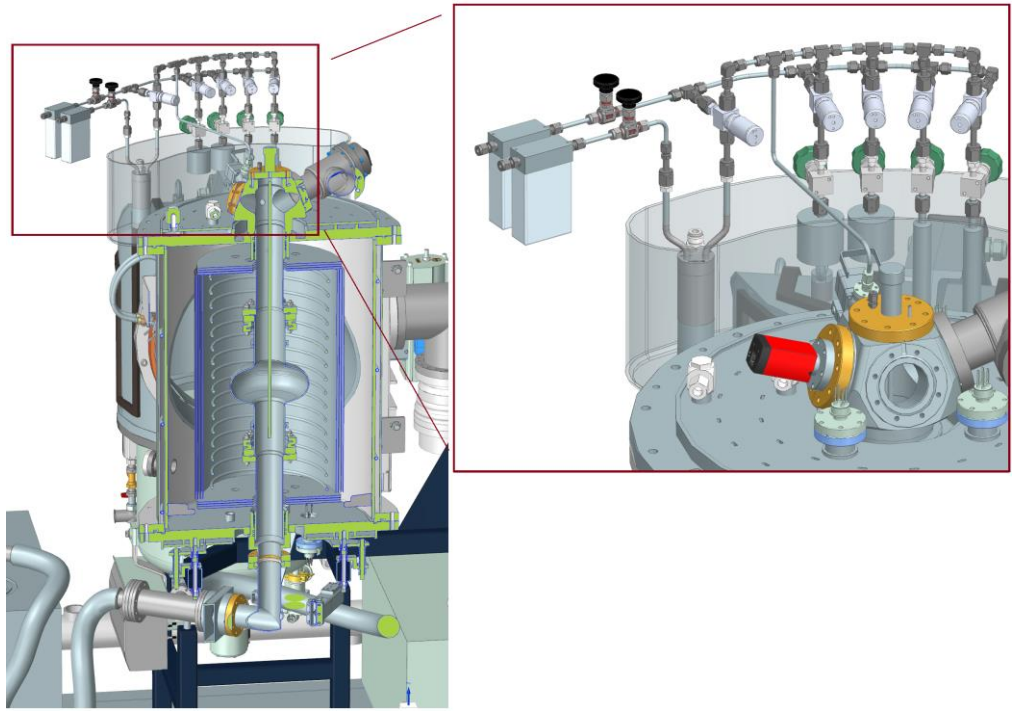
takes 2 month, start in 2 weeks

New MSc for QPR just started

# Copper coating with high $T_c$ superconductors & multilayers for 4K operation



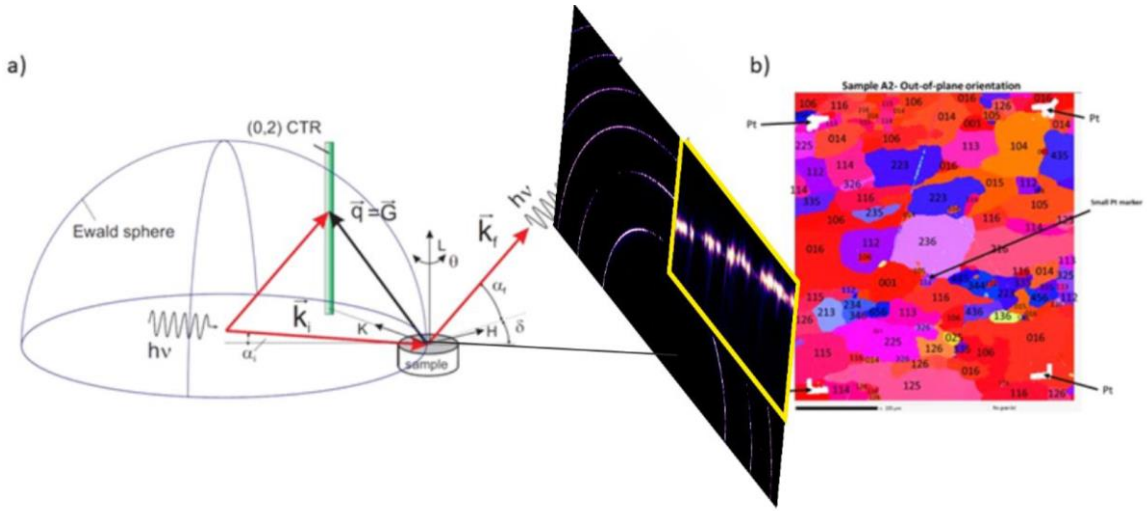



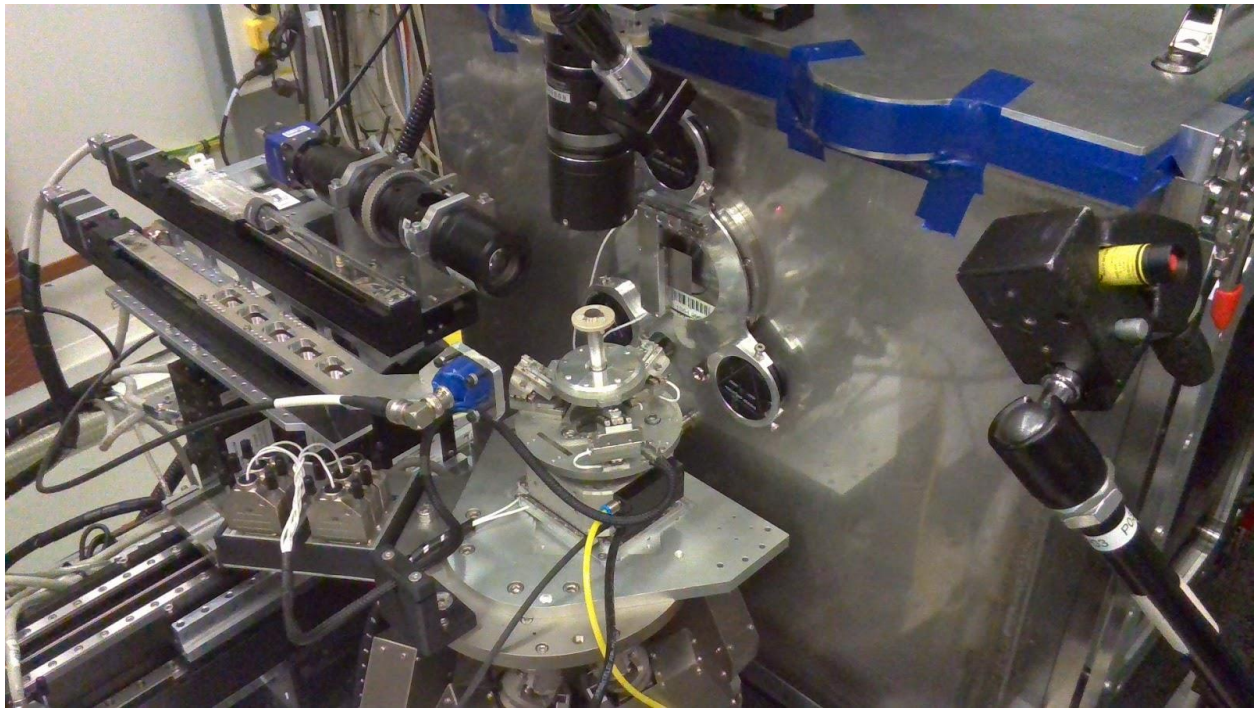



- As-deposited $T_c$ of NbTiN lower than $T_c$ of Nb
- Have to anneal at 900°C to achieve >14K
- Need to tailor our process to avoid 900°C anneal

# Grain mapping on polycristalline Nb

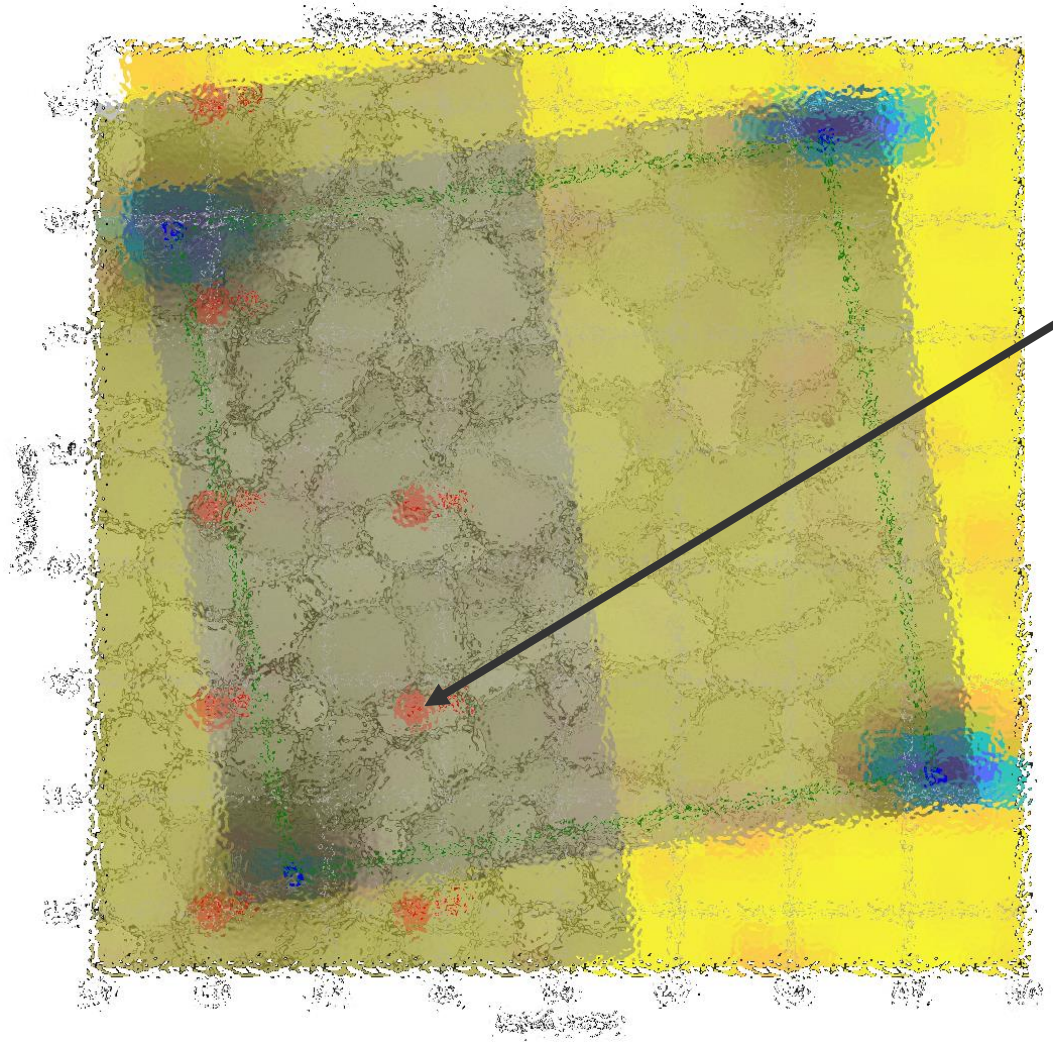
P03 @ PETRAIII
Grazing-incident angle microfocus X-ray scattering

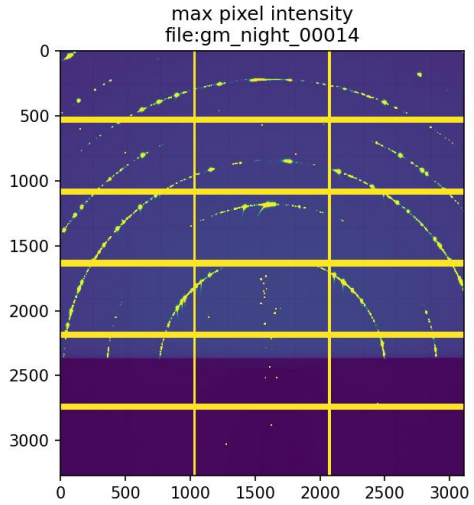


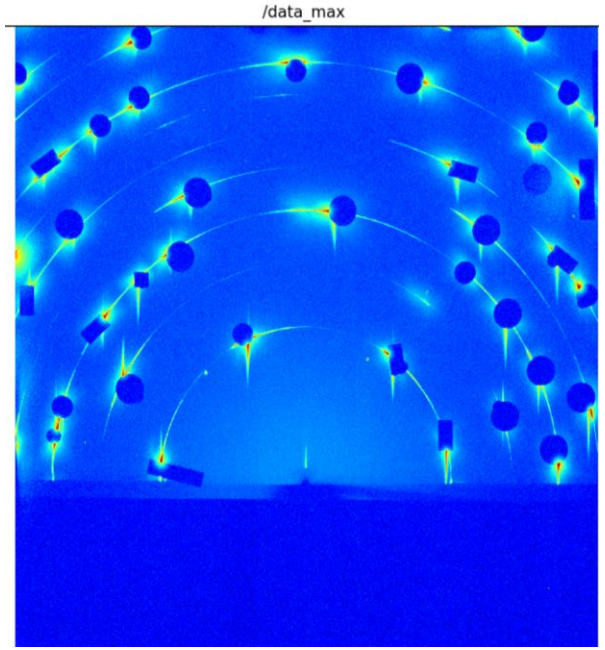



# Mapping works – it is just a lot of data

Analysis together with DASH-PhD student



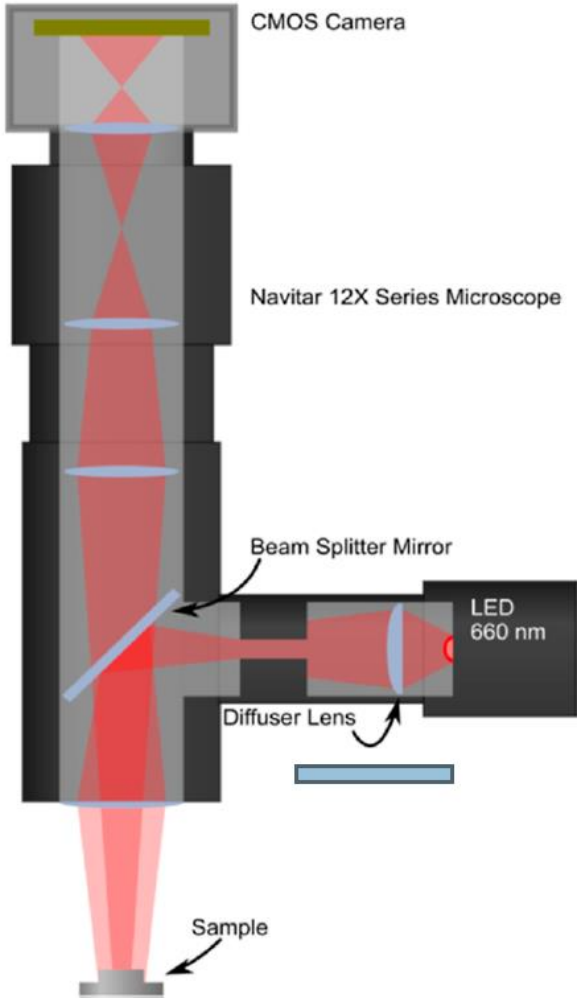


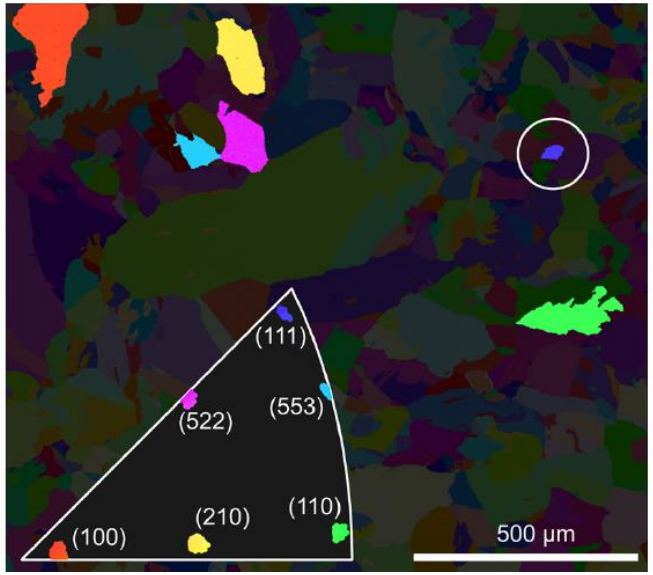



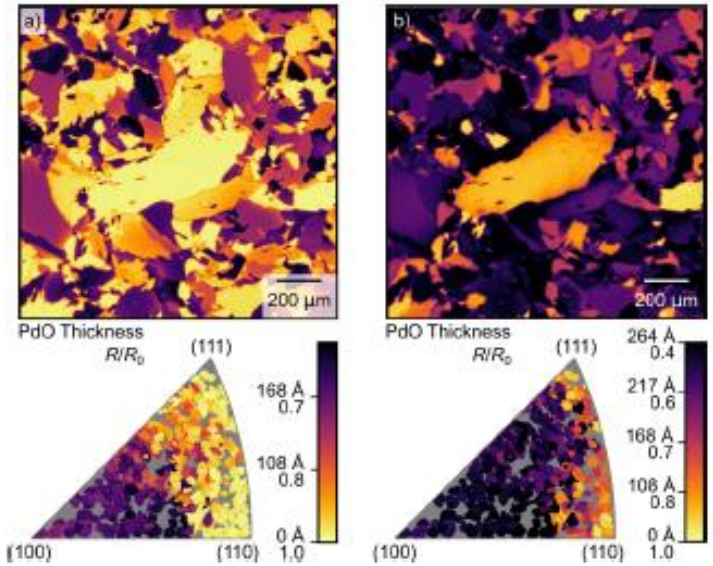

Single crystal

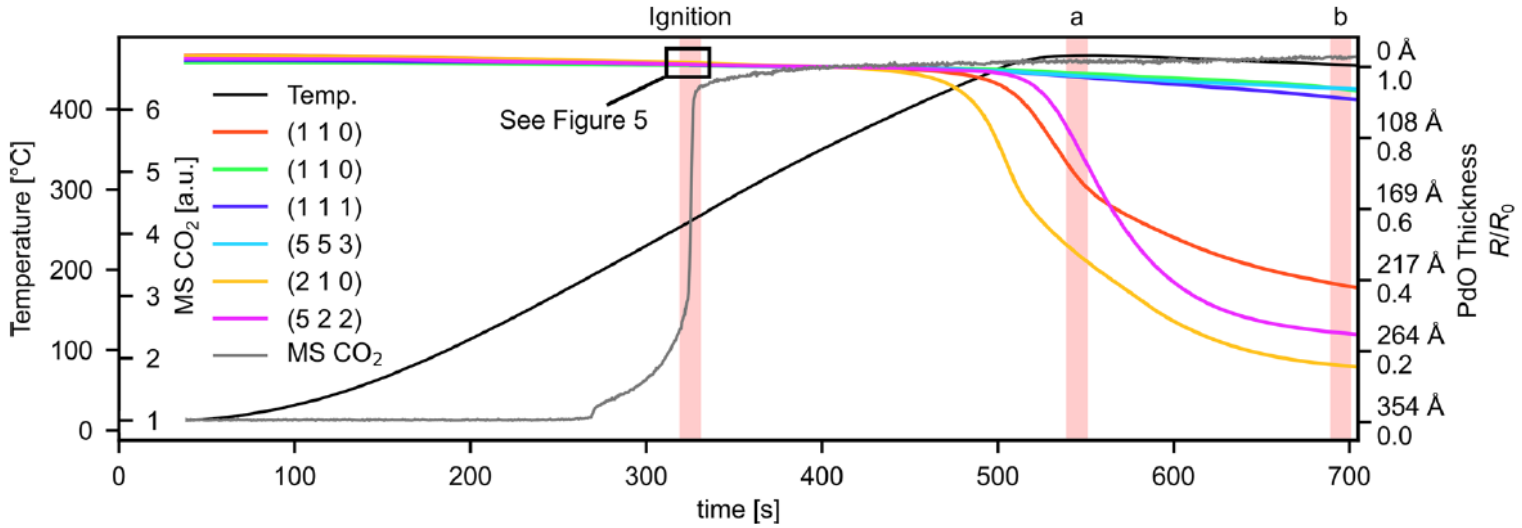
# SOR: Surface Optical Reflectance (Lund University)

[https://doi.org/10.1021/acsami.3c11341]

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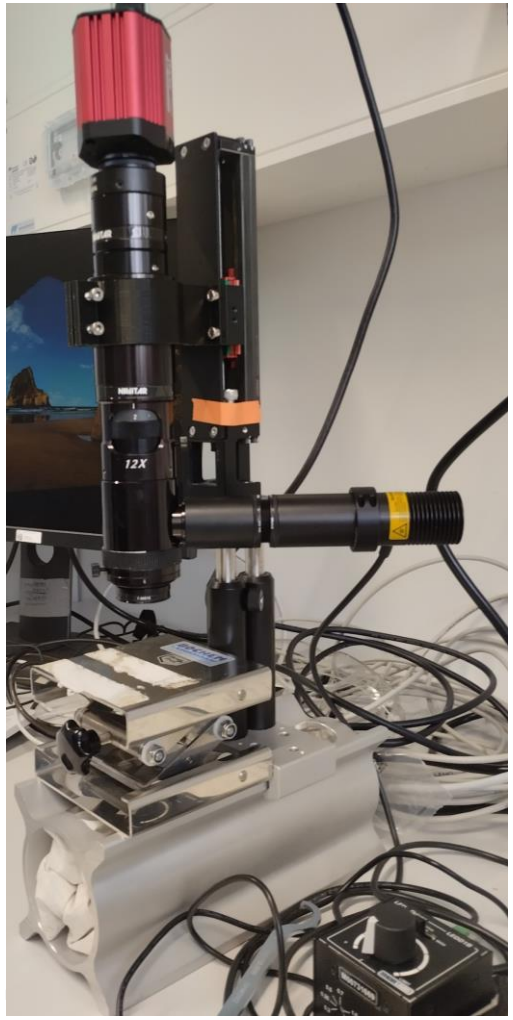
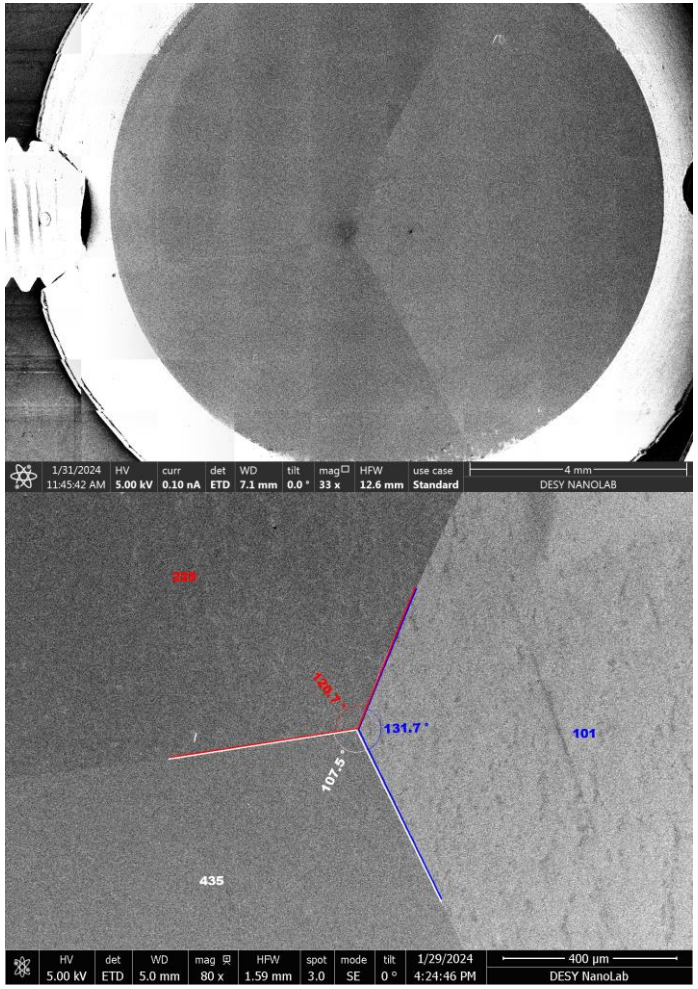
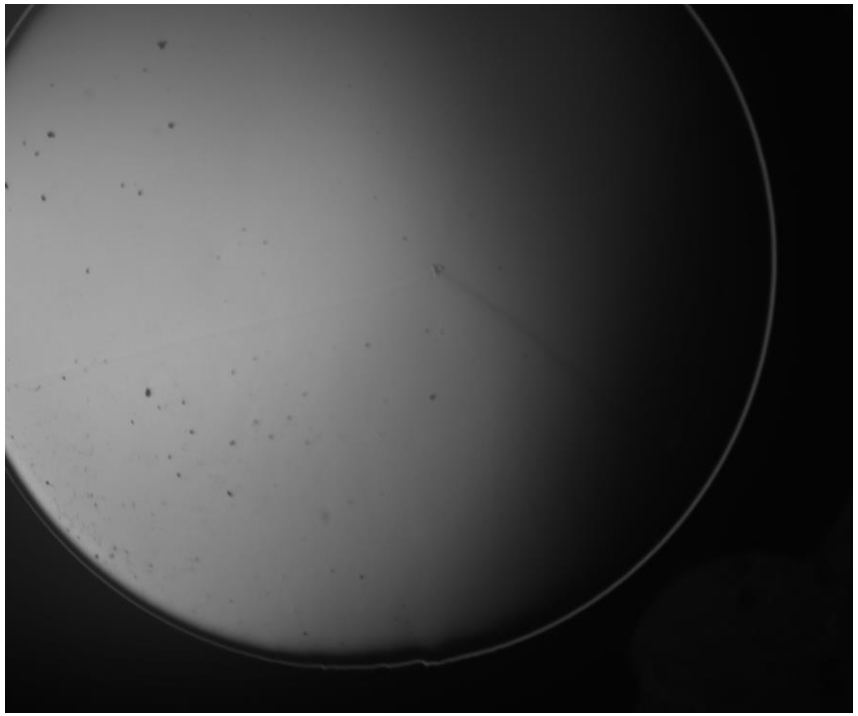
# SOR: Surface Optical Reflectance (Nanolab)

**<u>Our Goal:</u> measuring oxide thickness change on polycrystaline Nb samples**

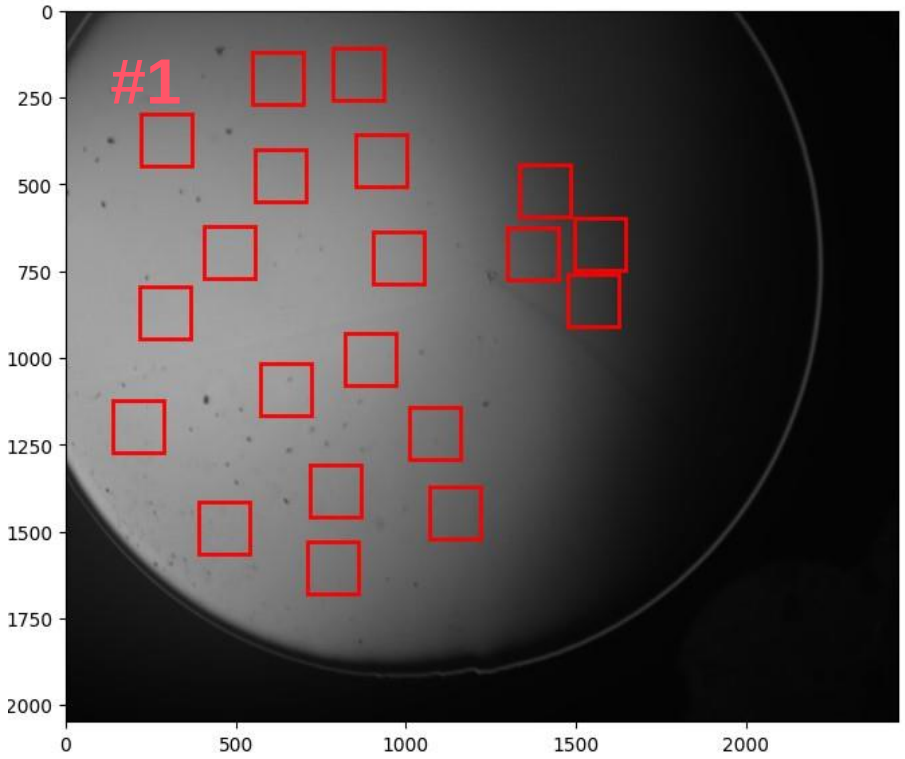


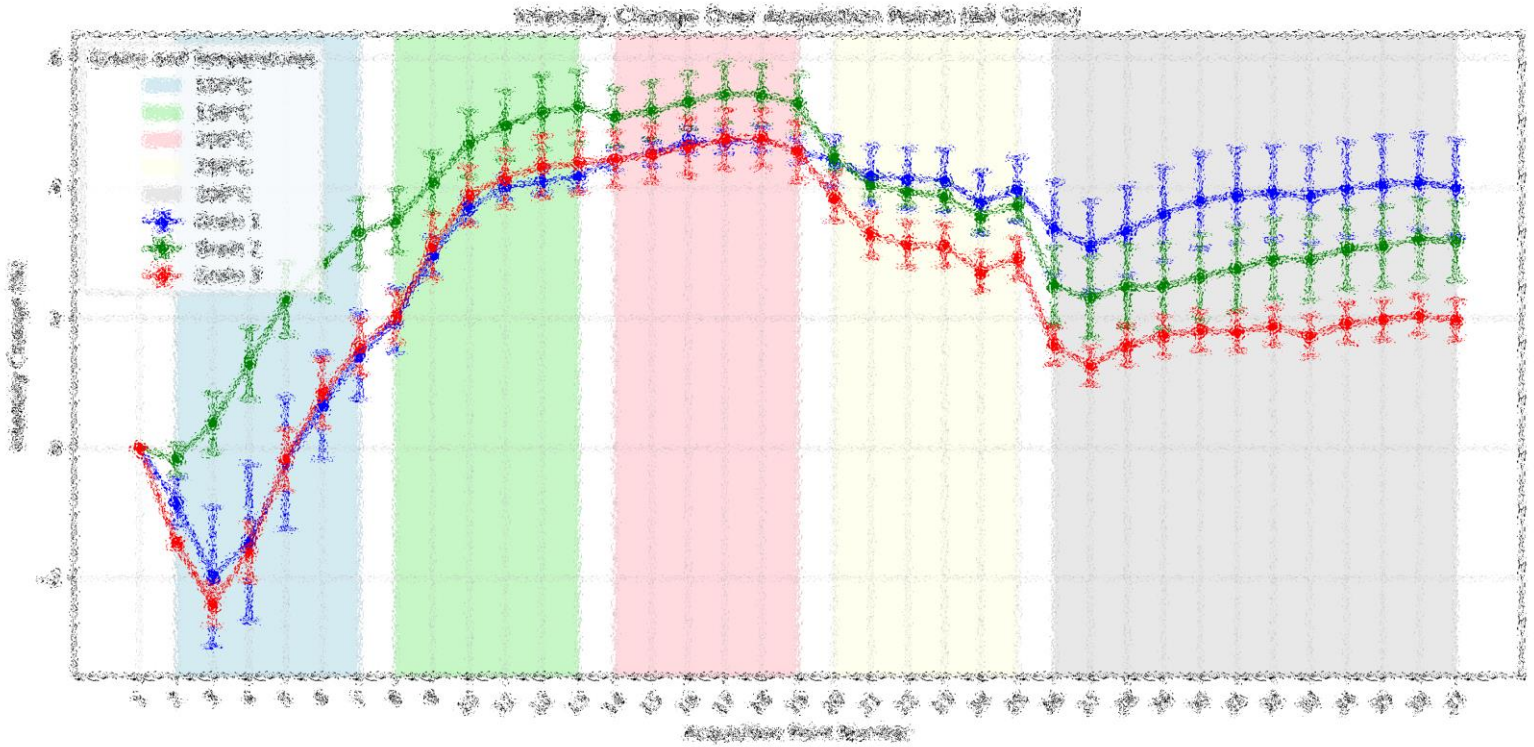



1st attempt: triple grain Nb sample

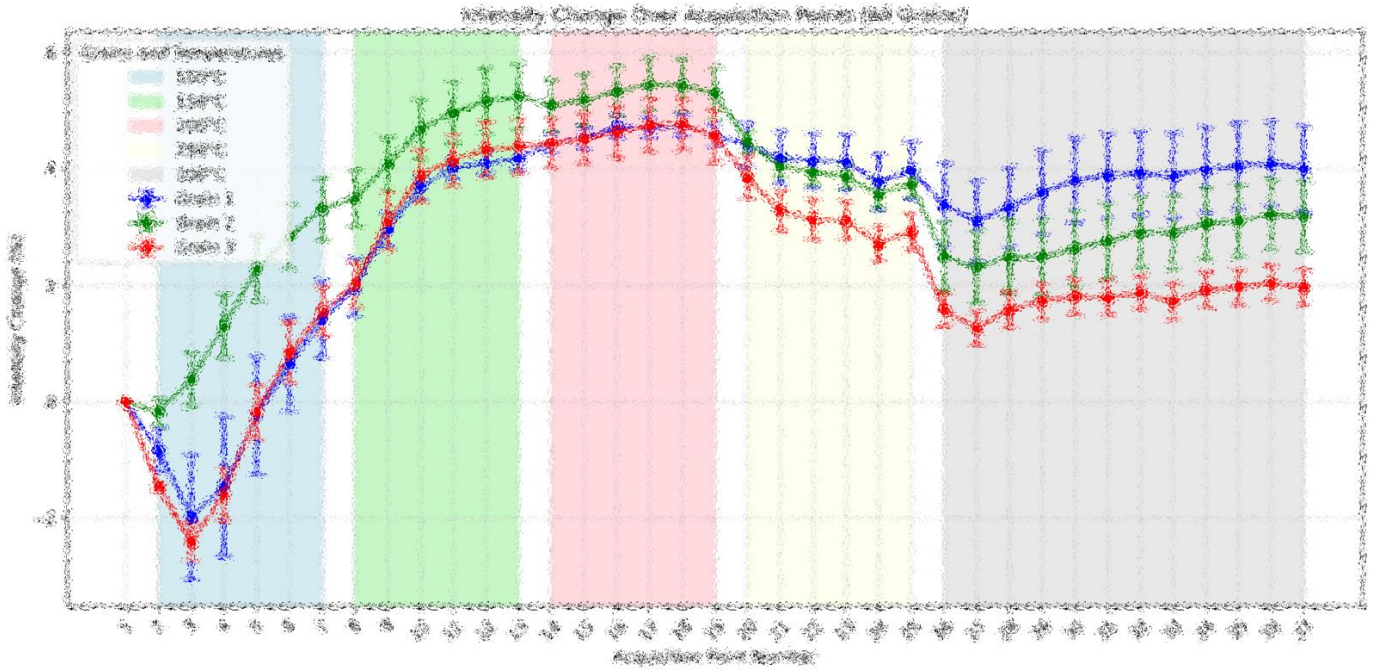
# First measurements see a change of reflectance vs. T

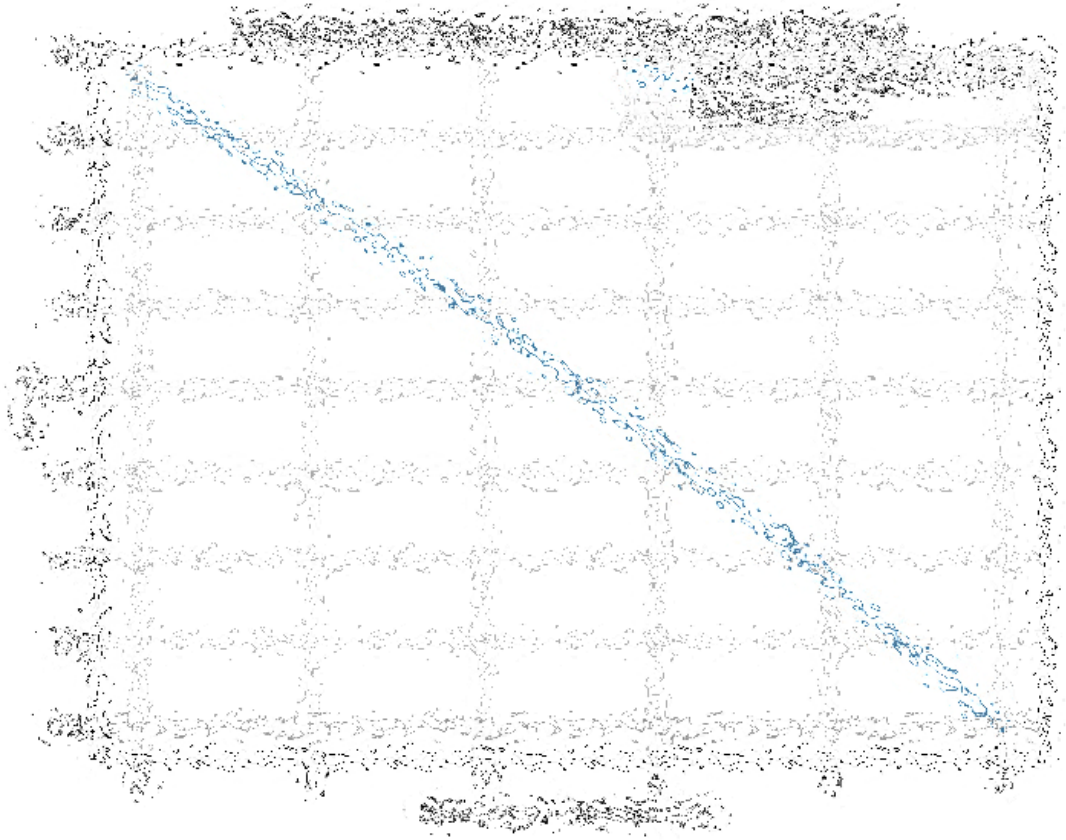


# Analysis ongoing and FG samples getting studied

Measurement vs. Simulation





# Conclusion: work in progress

- Neglected the Cu topic on purpose
  - New PEALD system has higher priority
  - Start to focus on this now as „light at the end of the tunnel“

- Material science is ongoing
  - X-ray based grain mapping works but a lot of data
  - Simpler, lab-based method getting studied