

# Recent results of N-infusion in DESY.

Marc Wenskat – on behalf of many!

Asian Linear Collider Workshop 2018 @ Fukuoka | 30.05.2018

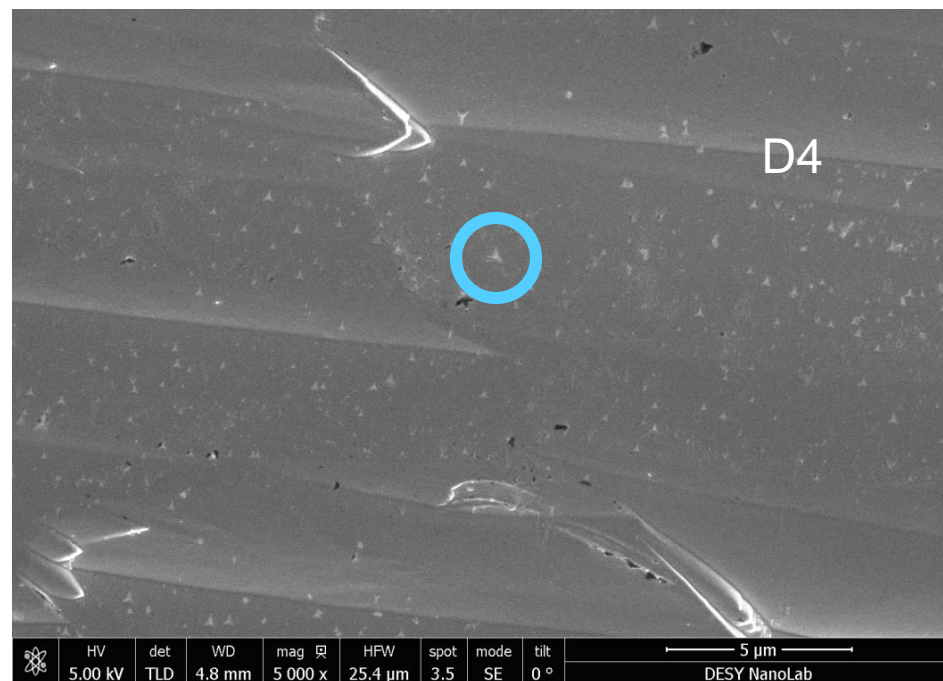
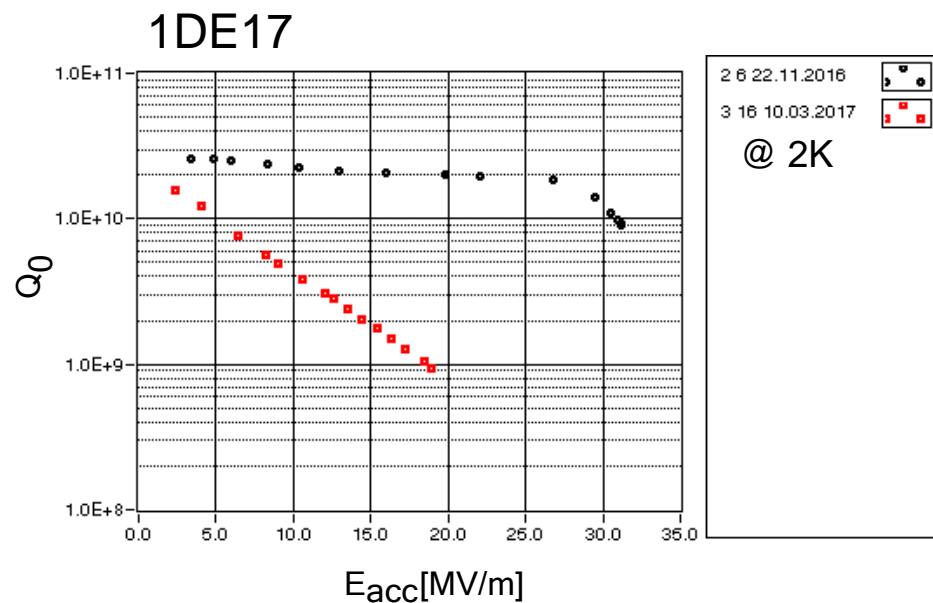


# DESY Furnace



- > 2 turbo molecular pumps (Varian, 6000 l/s each , max. intake pressure  $\sim 10^{-2}$  mbar)
- >  $T_{\text{max}} \sim 1100^{\circ}\text{C}$
- >  $V = 1800 \times 625 \times 660 \text{ mm}^3$
- > EPDM sealed
- > Roughing pumps (oil sealed):

# Second try - w/o Nitrogen



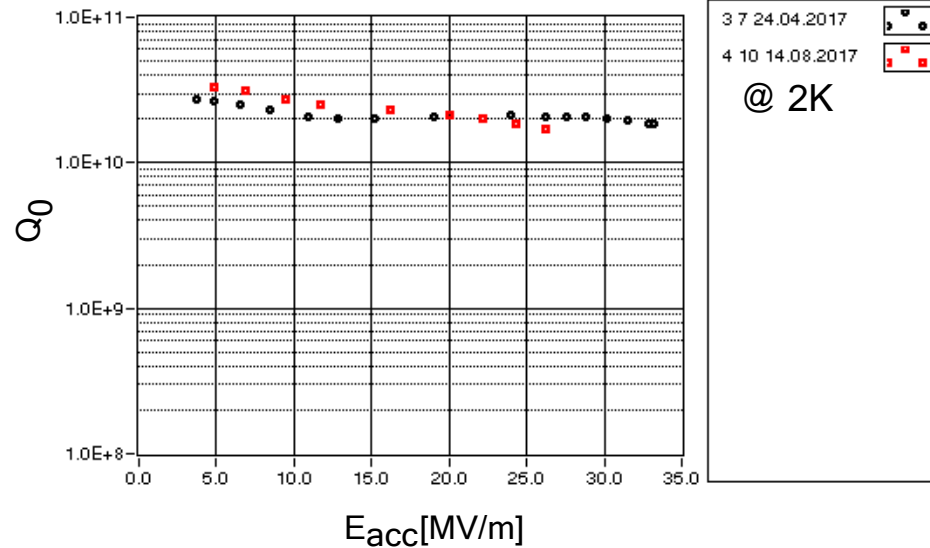
## Furnace parameters

800°C @ 2h,  $p \approx 10^{-5}$  mbar

120°C @ 48h,  $p \approx 10^{-7}$  mbar

# Third try - w/o Nitrogen

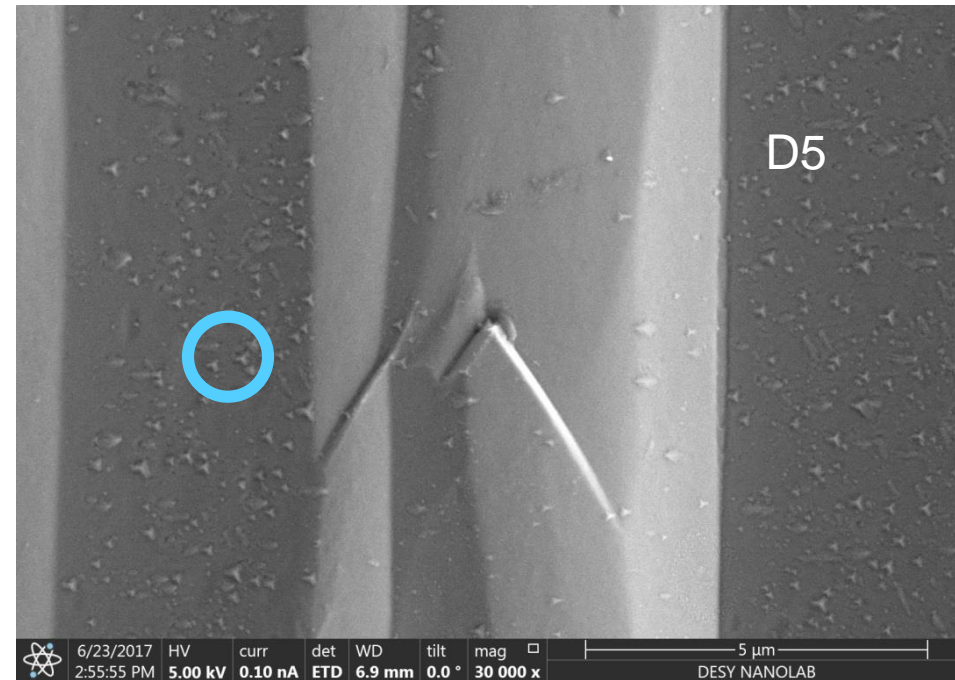
1DE16



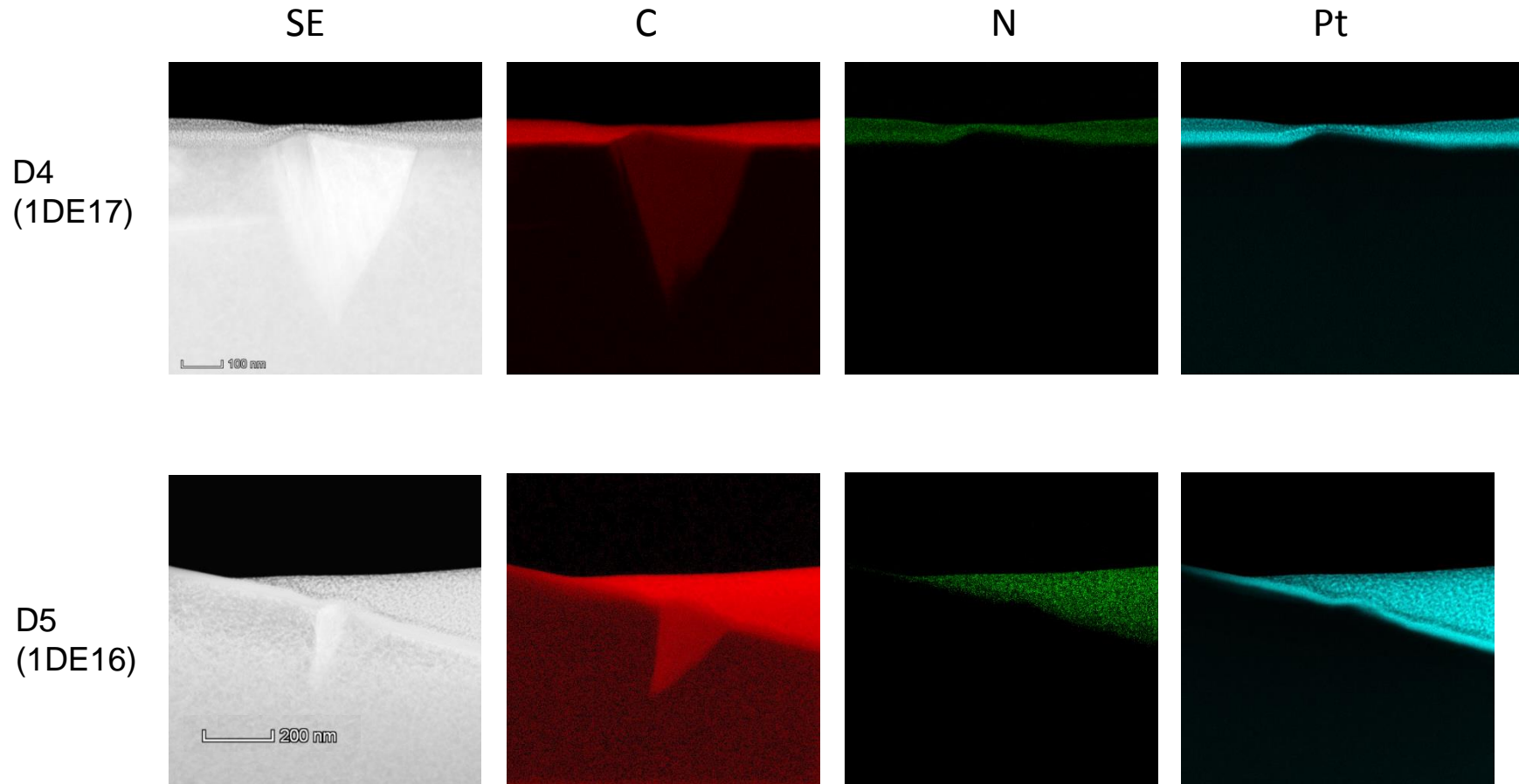
## Furnace parameters

800°C @ 3h,  $p \approx 7.5 \cdot 10^{-6}$  mbar

120°C @ 48h,  $p \approx 10^{-7}$  mbar



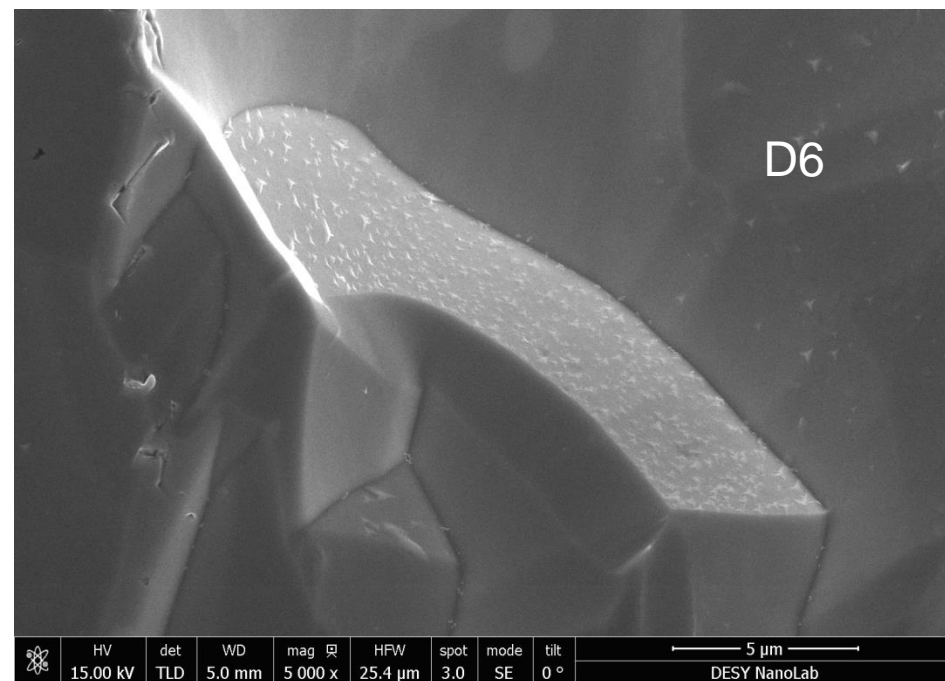
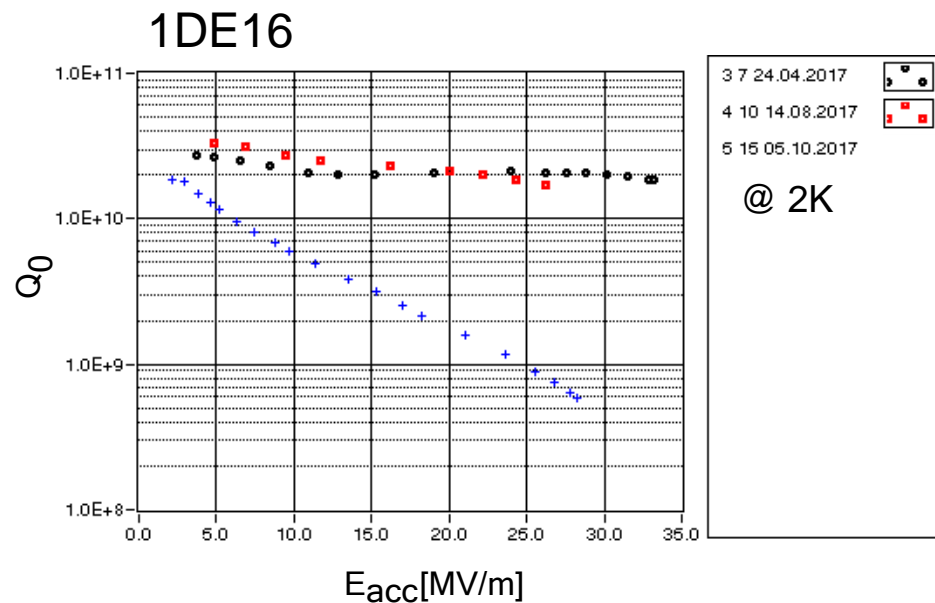
# Cross-section EDX map



Possible phase:  $\beta\text{-Nb}_2\text{C}$



# Fourth try - w/o Nitrogen – 2nd 1DE16 run



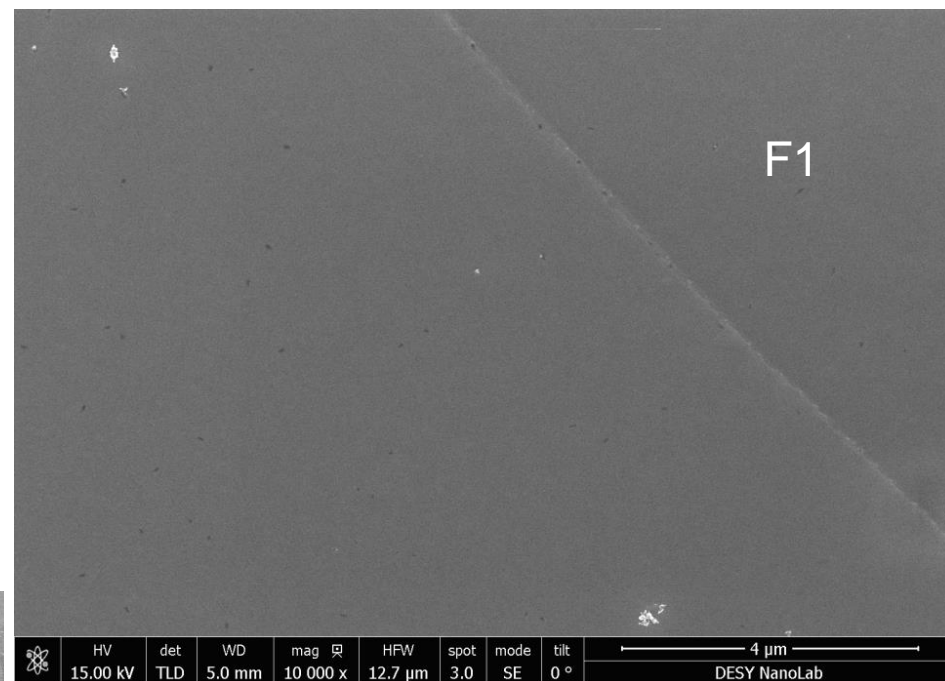
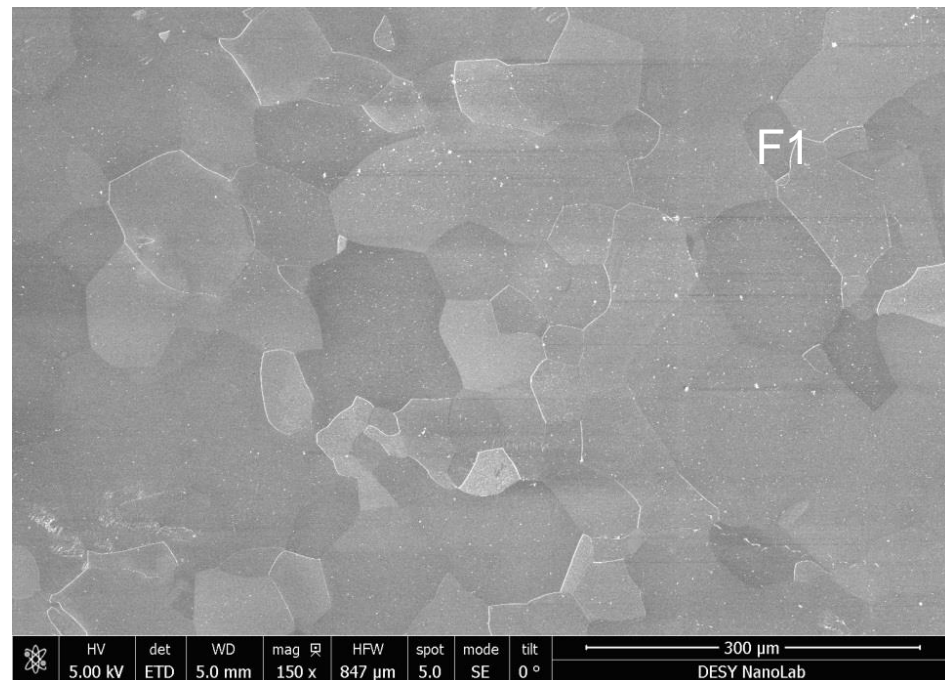
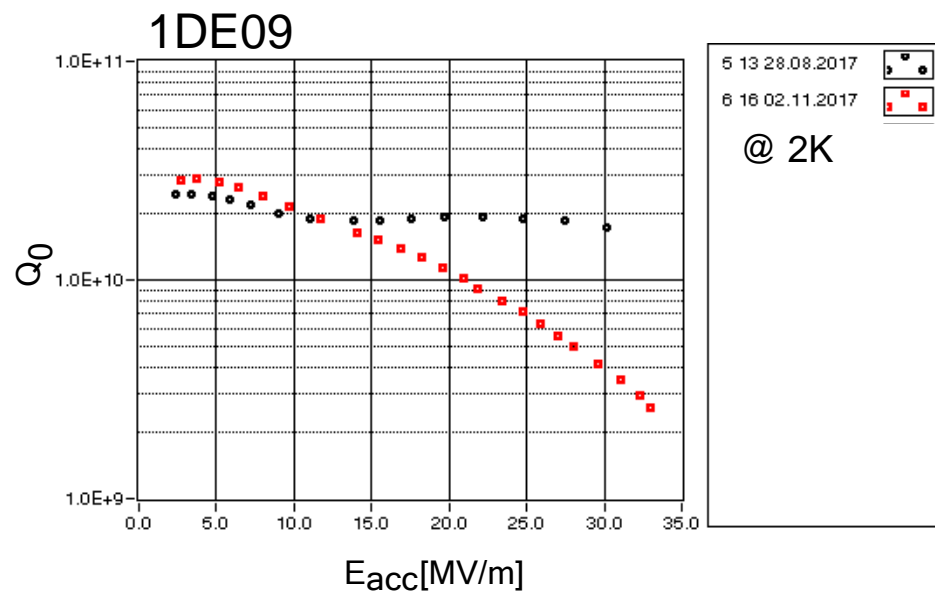
## Furnace parameters

800°C @ 3h,  $p \approx 5.6 \cdot 10^{-6}$  mbar

120°C @ 48h,  $p \approx 10^{-7}$  mbar

- > Observing precipitates on sample (BCP)
- > **Only on certain grains!**
- > Dense and numerous

# Fifth try - w/o Nitrogen



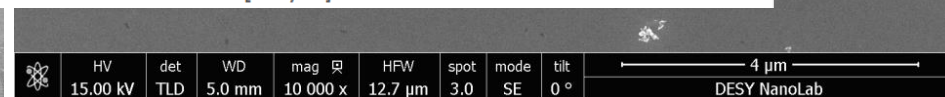
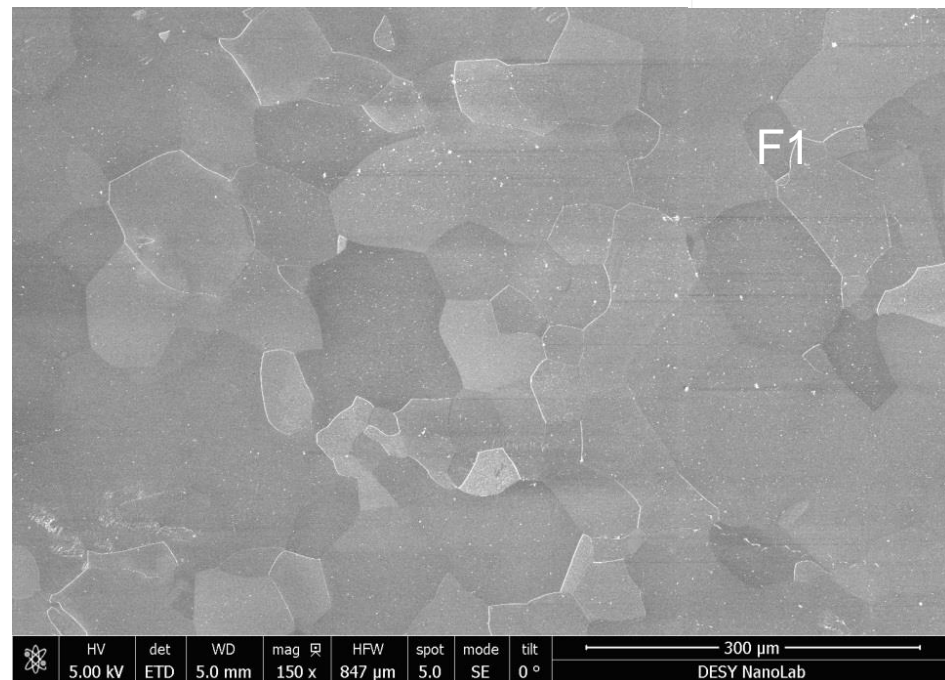
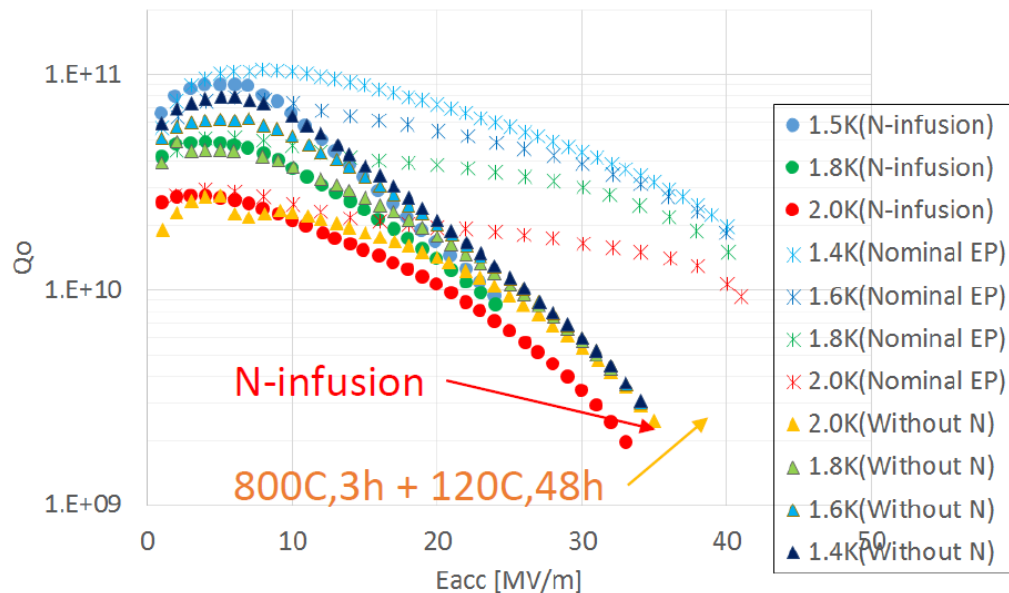
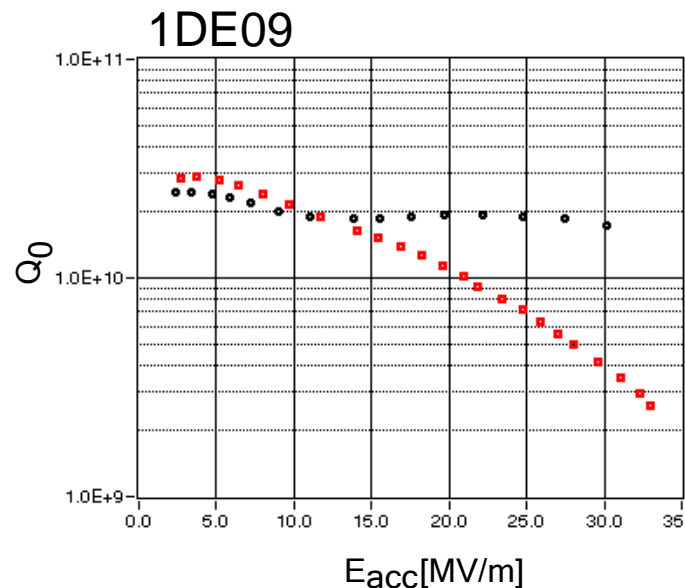
## Furnace parameters

800°C @ 3h,  $p \approx 5 \cdot 10^{-6}$  mbar

120°C @ 48h,  $p \approx 10^{-7}$  mbar

# Fifth try - w/o Nitrogen

R-2(Tokyo-Denaki FG, single-cell) VT13 ~800C x 3h + 120C x 48h w/o N~



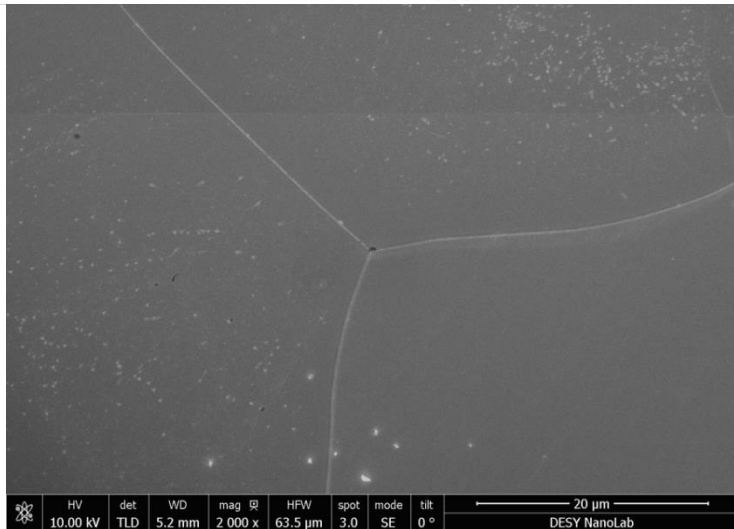
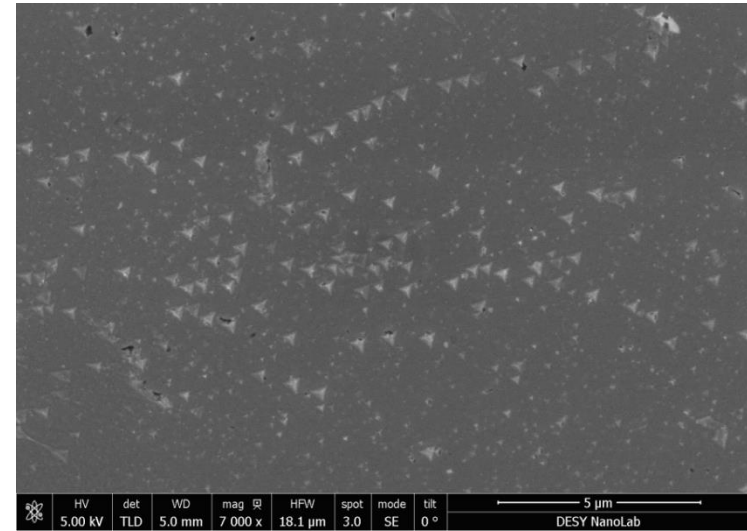
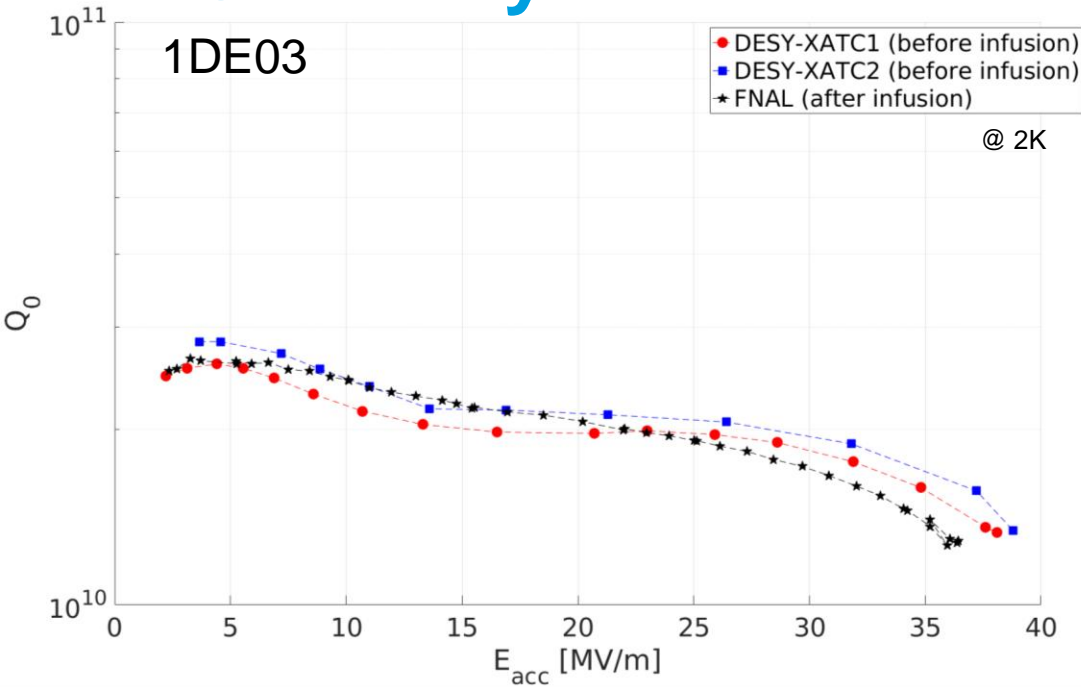
## Furnace parameters

800°C @ 3h,  $p \approx 5 \cdot 10^{-6}$  mbar

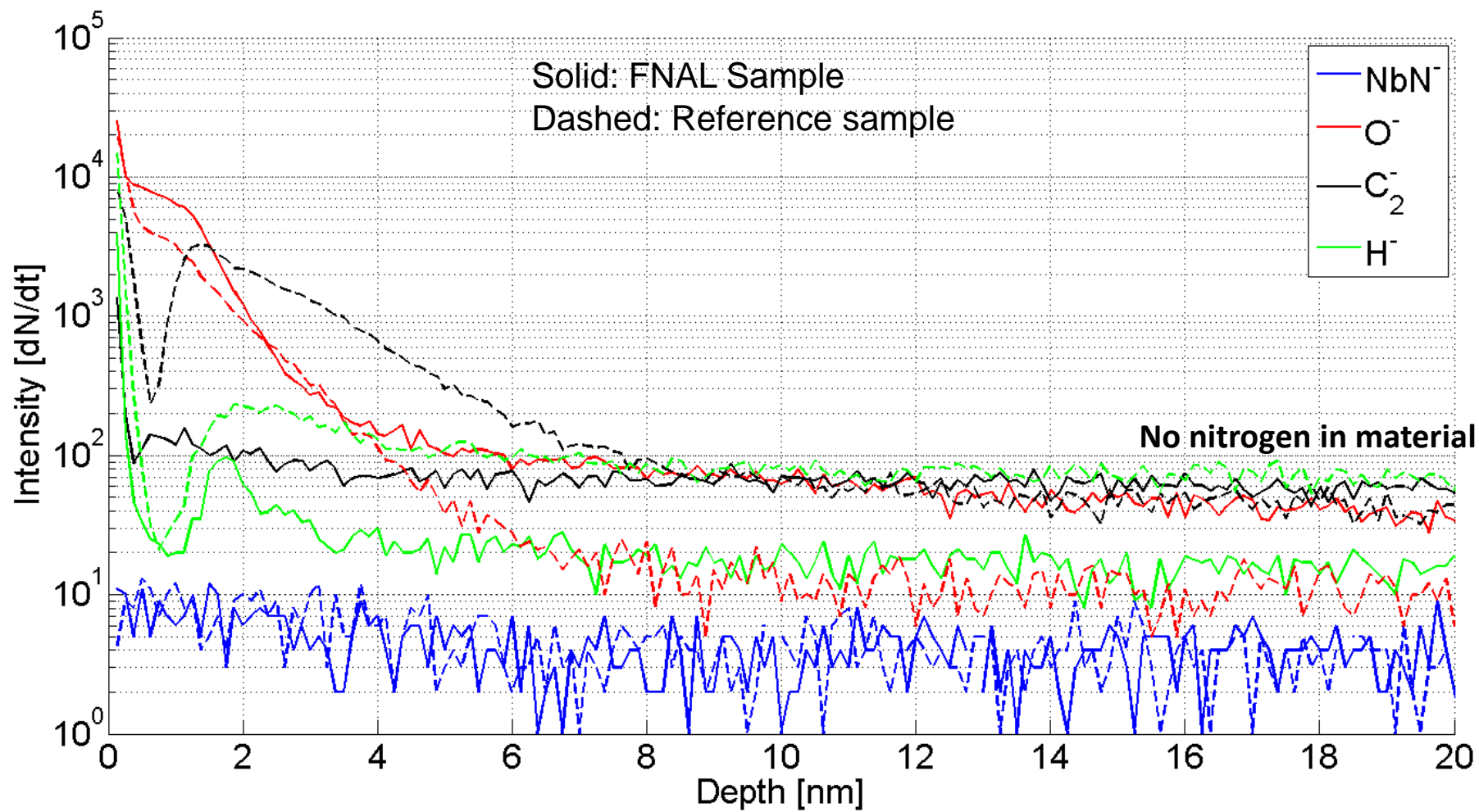
120°C @ 48h,  $p \approx 10^{-7}$  mbar



# DESY cavity - infusion run at Fermilab



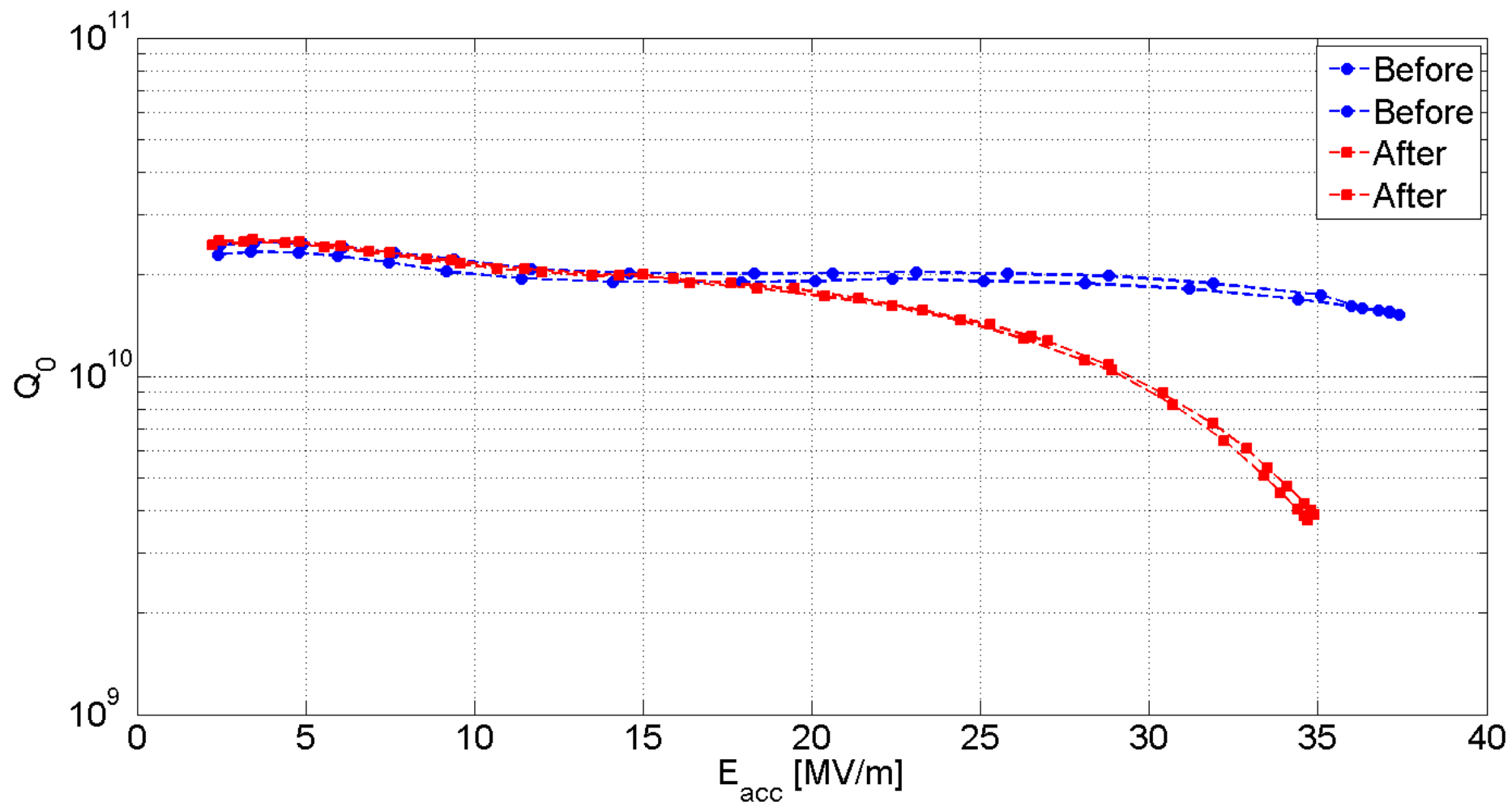
# DESY cavity - infusion run at Fermilab



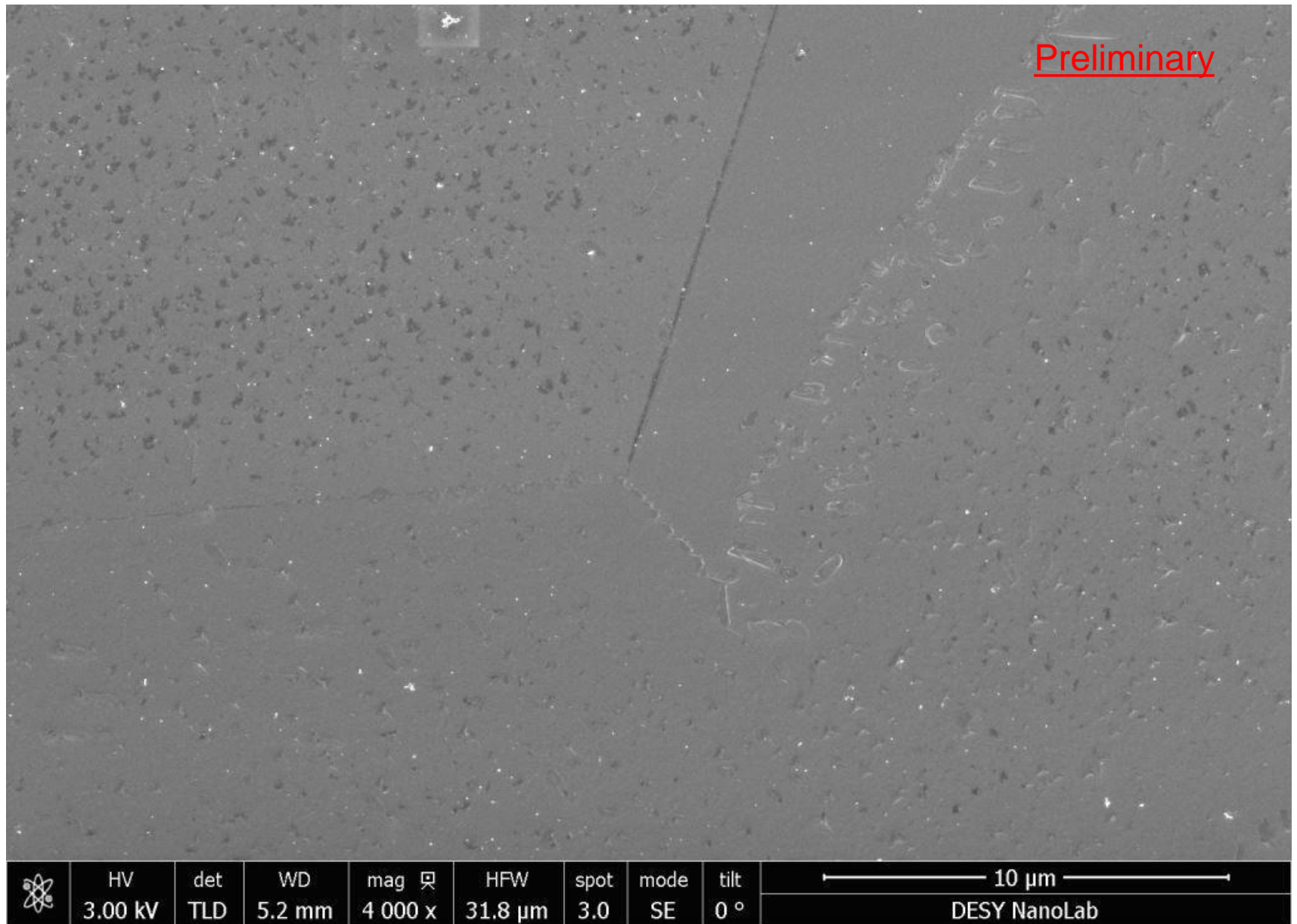
# Sixth try - with Nitrogen

1DE10

Preliminary



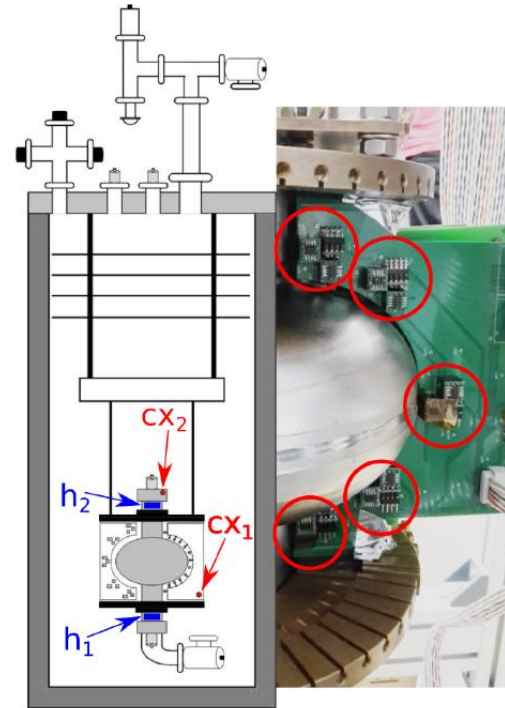
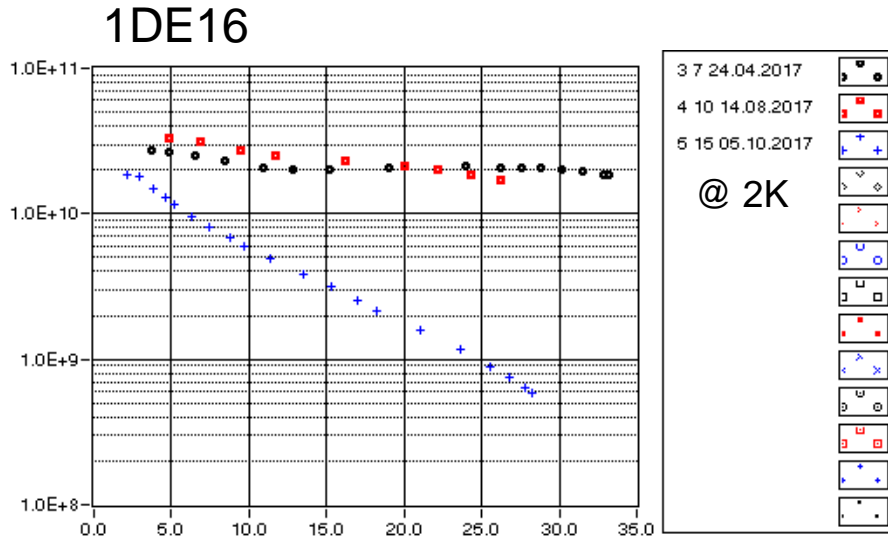
# Sample 1DE10





# Samples = Cavity Surface?

T-Map & H-Map @ HZB



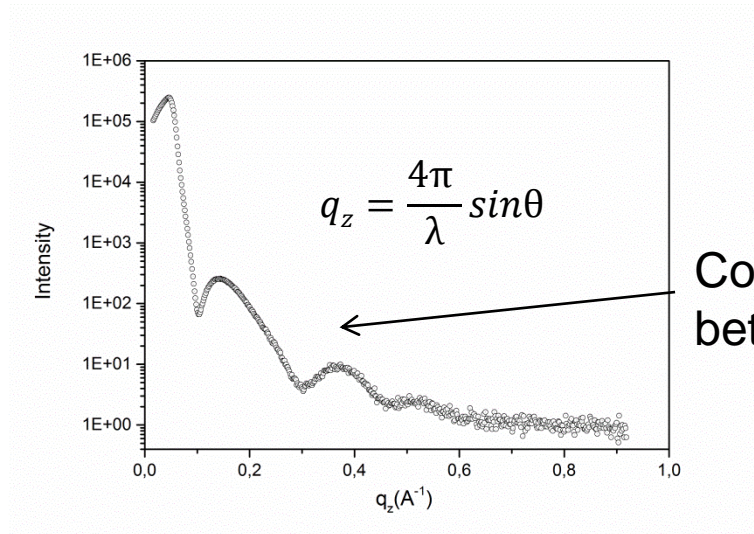
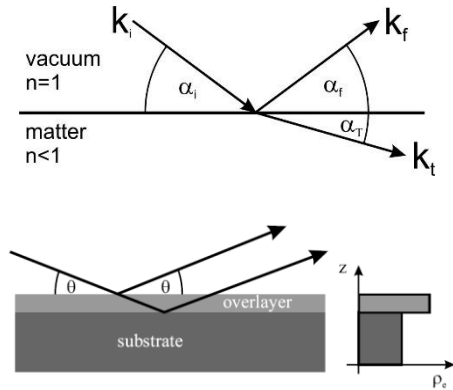
- Use data from
  - 2<sup>nd</sup> Sound & T-Map & Optical inspection before 1<sup>st</sup> infusion run
  - 2<sup>nd</sup> Sound after 1<sup>st</sup> infusion run
  - T-Map & H-Map after 2<sup>nd</sup> infusion run (at HZB right now)
- Cut samples from cavity (hot & cold Spots)

# Summary & next steps

- “Evolution” of cavity deterioration
  - Improvements on furnace (bake outs / pumping logic / pre-bake) reflected in cavity performance
  - 1DE9 performance similar to KEK
  - Will reproduce 1DE10 run in KW24 with another cavity
- Collaboration with FNAL
  - 1DE3 (FG) treatment failed – but didn’t deteriorate
  - Baseline measurement took place after reset
  - 2<sup>nd</sup> cavity (LG) prepared as well – both will be treated together
- Sample R&D
  - How comparable are cavity surface and samples?
  - A systematic sample R&D program is ready to go

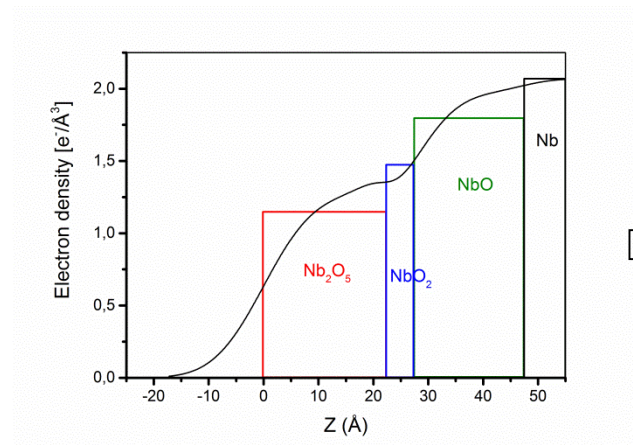


# X-Ray Reflectivity



- Thickness ( $d$ )
- Layer density profile ( $\rho_e$ )
- Surface or interface roughness ( $\sigma$ )

Independent of crystalline state



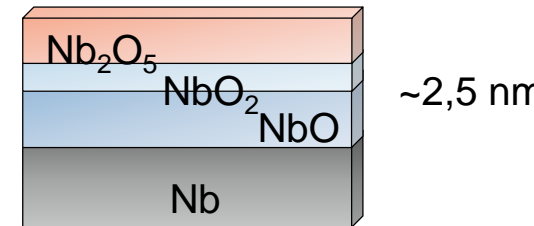
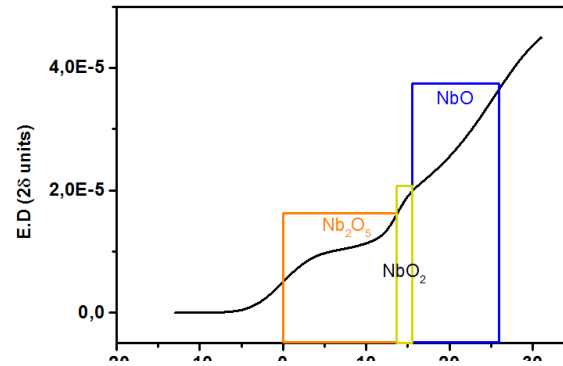
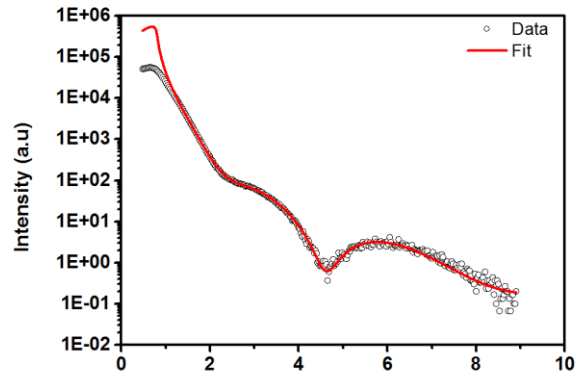
Electron density profile



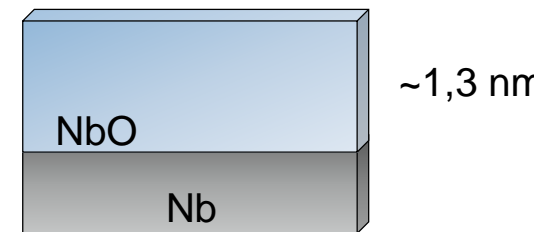
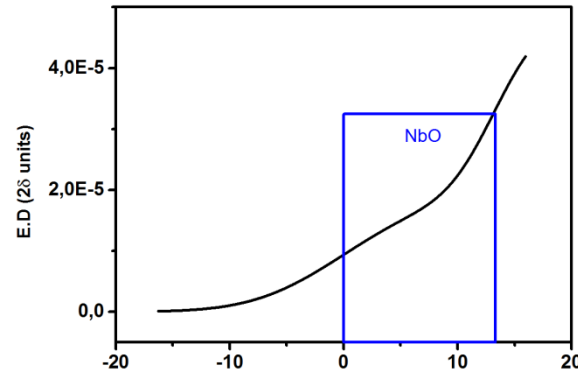
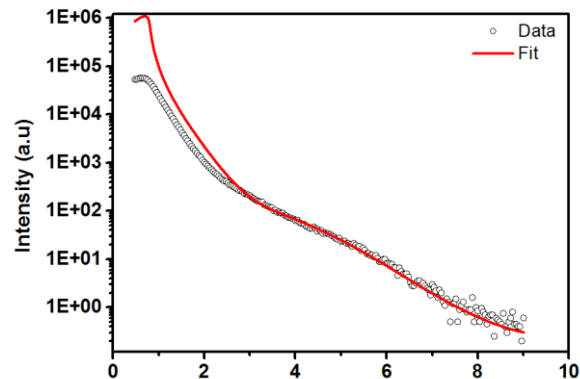
# In-Situ Sample R&D

## Single Crystal – Infusion Recipe

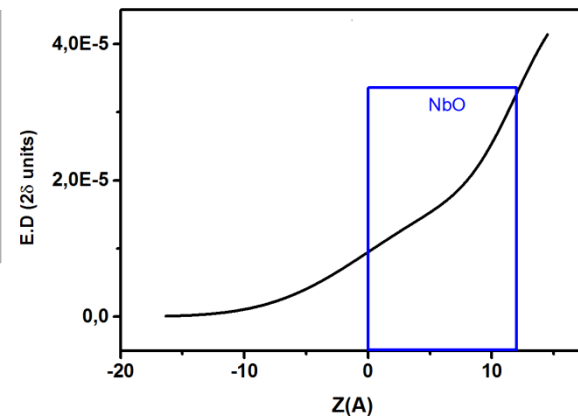
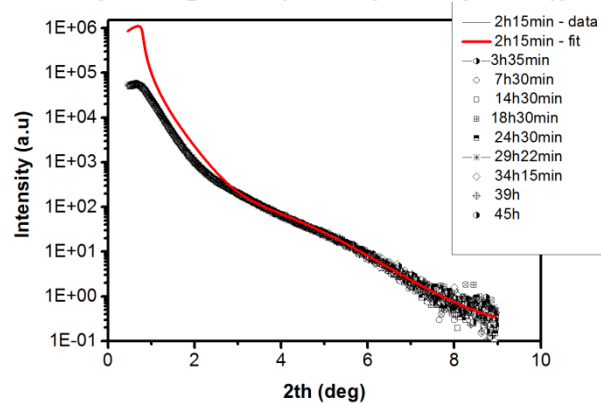
RT



800°C/2h



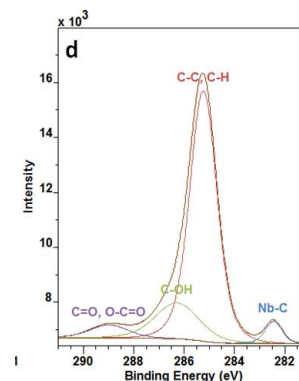
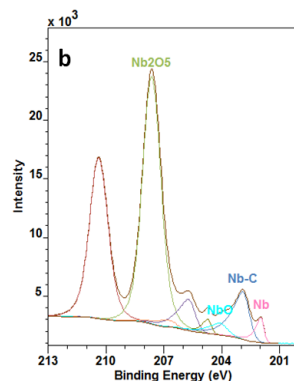
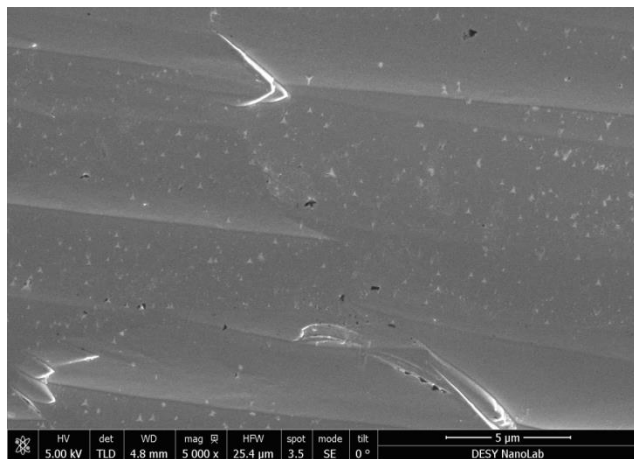
N-infusion  
48 hrs



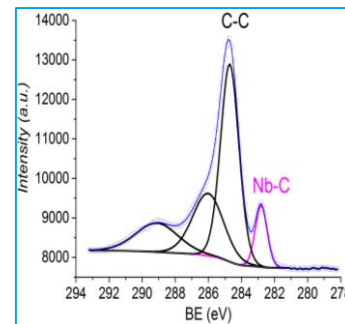
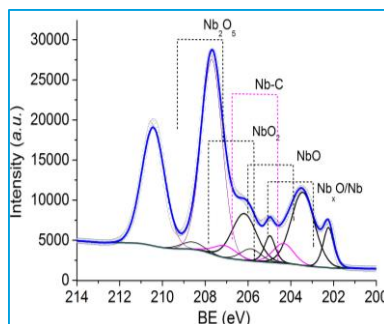
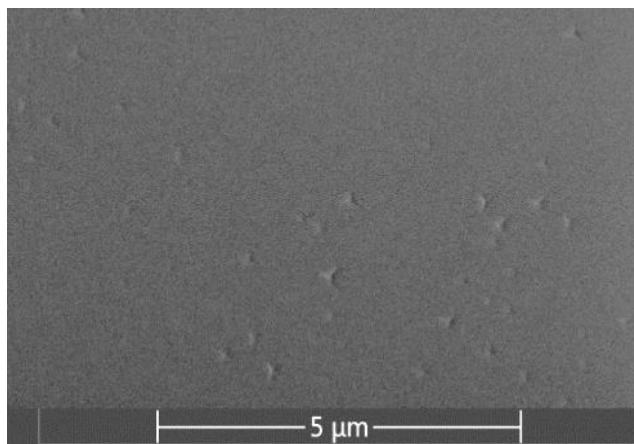
# In-Situ Sample R&D

Cavity Grade Material Preliminary

XPS



Baked w/o N in large furnace



Infused in sample chamber w N

Nb-C shows up on Cavity Grade material  
**NOT** on pure single crystal material!

# Modified Infusion Recipe

## ESRF – GIXRD – Surfacerlayer & Interstitials

### Preliminary

