

# Status Update on the Nitrogen Infusion R&D at DESY

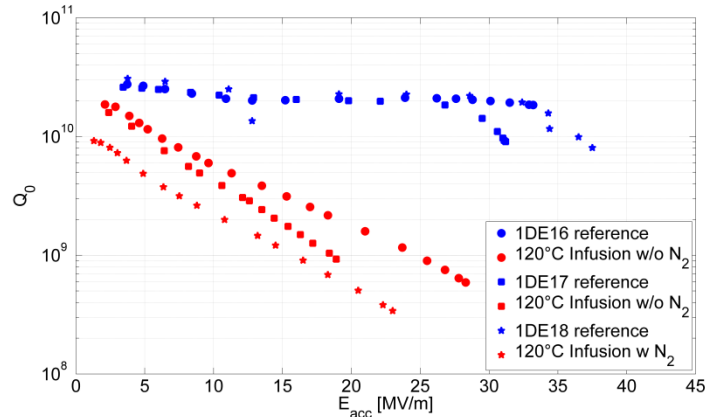


Marc Wenskat on behalf of the SRF team at DESY  
LCWS 2018, Arlington, Texas – 25.10.2018

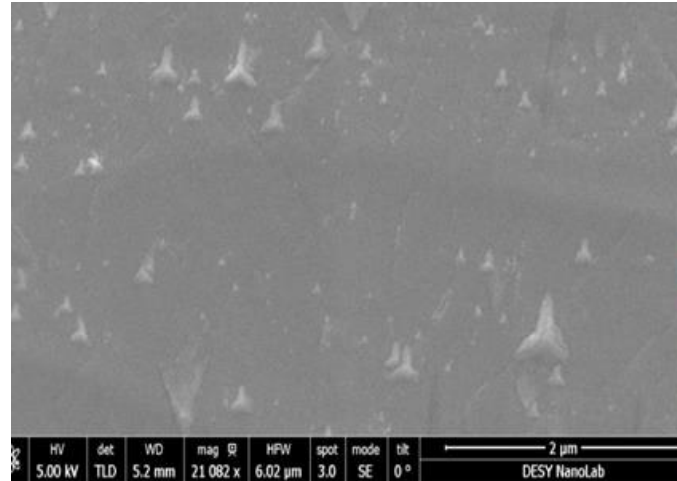
**HELMHOLTZ** RESEARCH FOR  
GRAND CHALLENGES



# Whats going on?



	IDE18	IDE17	IDE16
Material	Ningxia fine grain	Ningxia fine grain	Plansee fine grain
Reference @ 2K			
$E_{acc,max} [\frac{MV}{m}]$	37.7 - BD	31.2 - BD	32.2 - BD
$Q_0(4 MV/m)[\times 10^{10}]$	2.8	2.5	2.7
Baking Parameters			
$p @ 800^\circ C$ [mbar]	$2 \times 10^{-5}$	$1.1 \times 10^{-5}$	$5.5 \times 10^{-6}$
$P_{N_2} @ 120^\circ C$ [mbar]	7 - 300 $\times 10^{-5}$	w/o	w/o
RF Test @ 2K			
$E_{acc,max} [\frac{MV}{m}]$	20.2 no FE	19.5 no FE	26.3 - BD no FE
$Q_0(4 MV/m)[\times 10^{10}]$	0.5	1.2	3.2

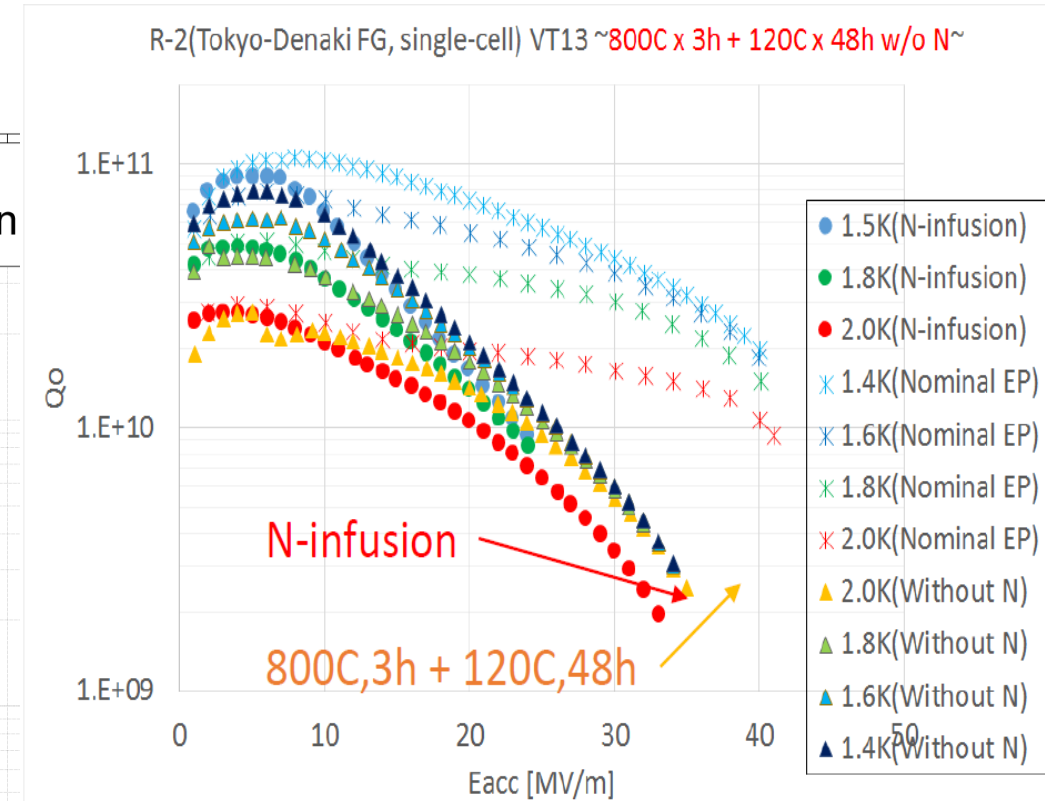
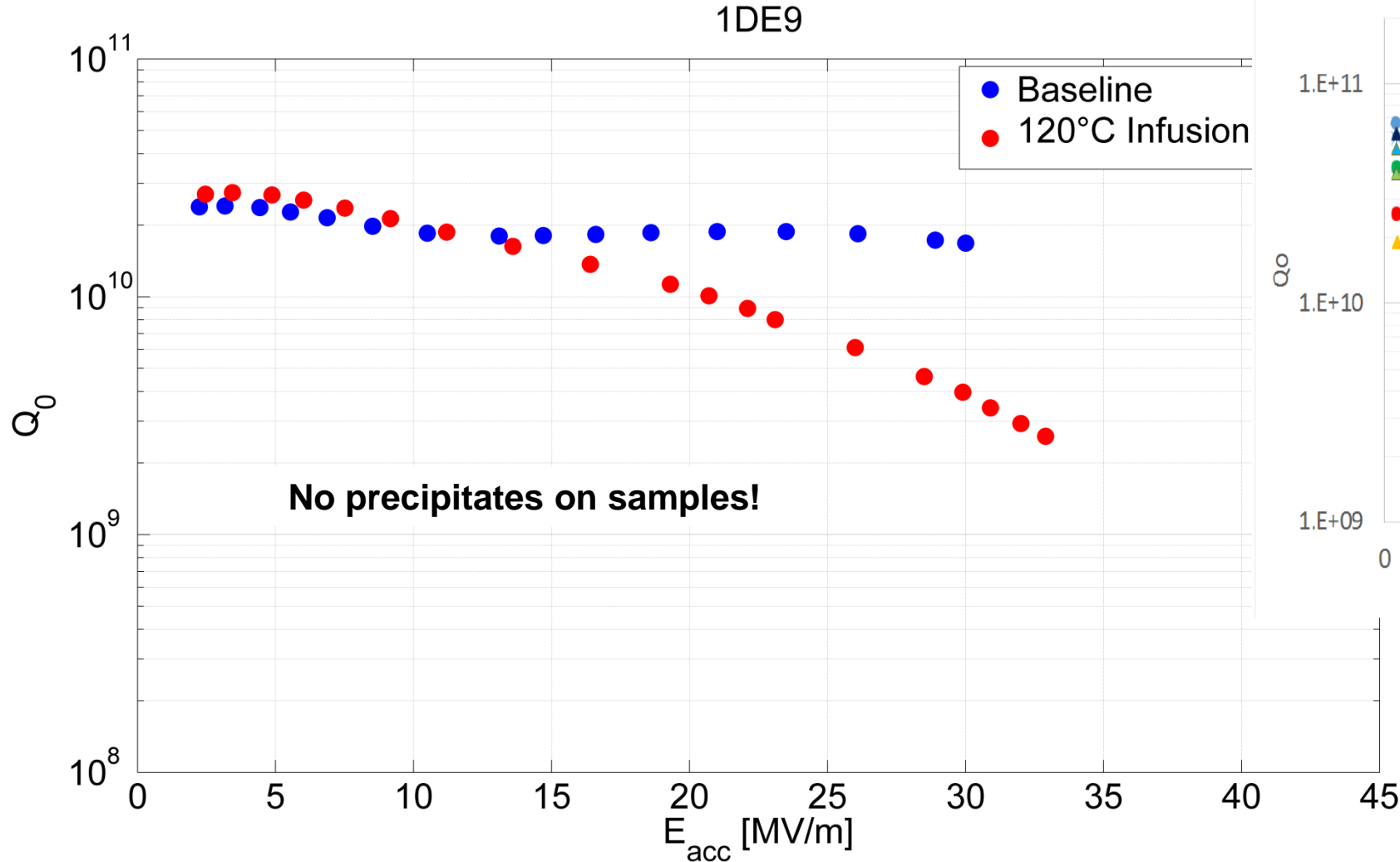


RGA during 800°C bake showed high mass contributions (Hydrocarbons)

Samples within a standard 800°C bake showed precipitates as well

# Fifth Infusion Run

w/o Nitrogen – just temperature cycle



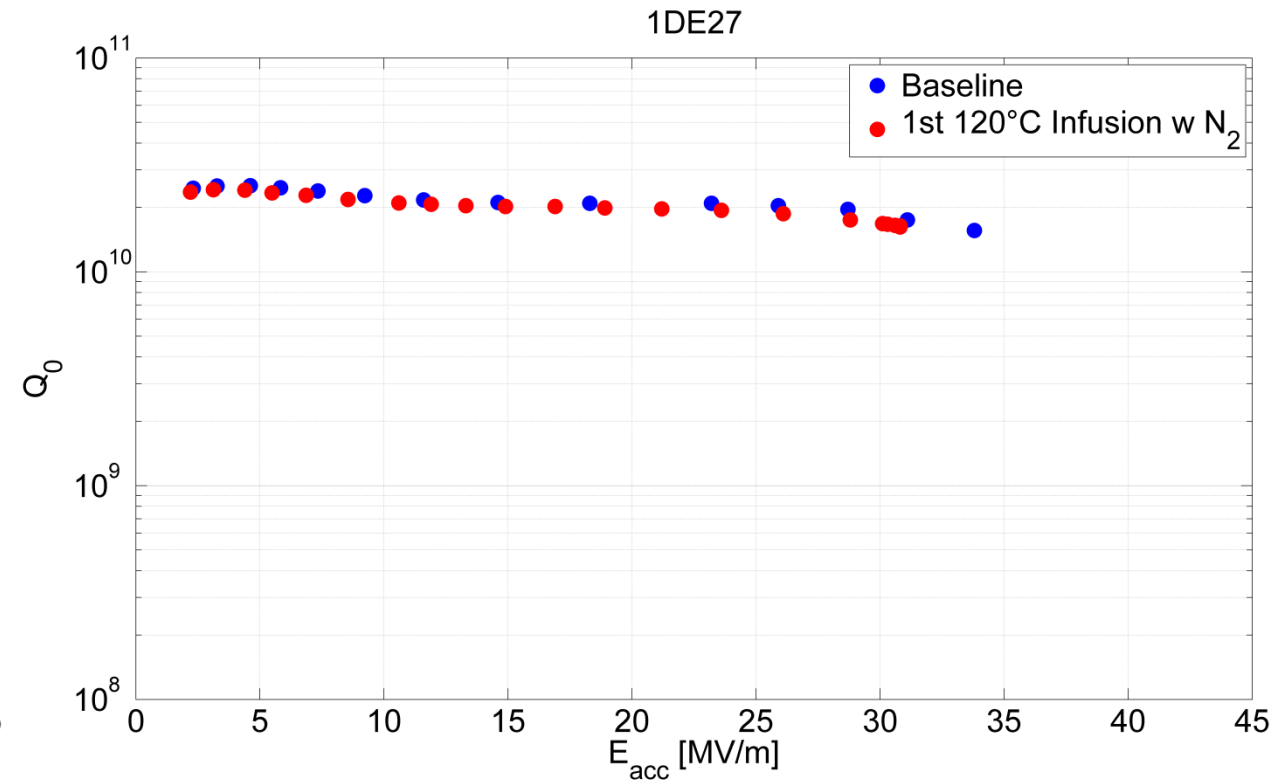
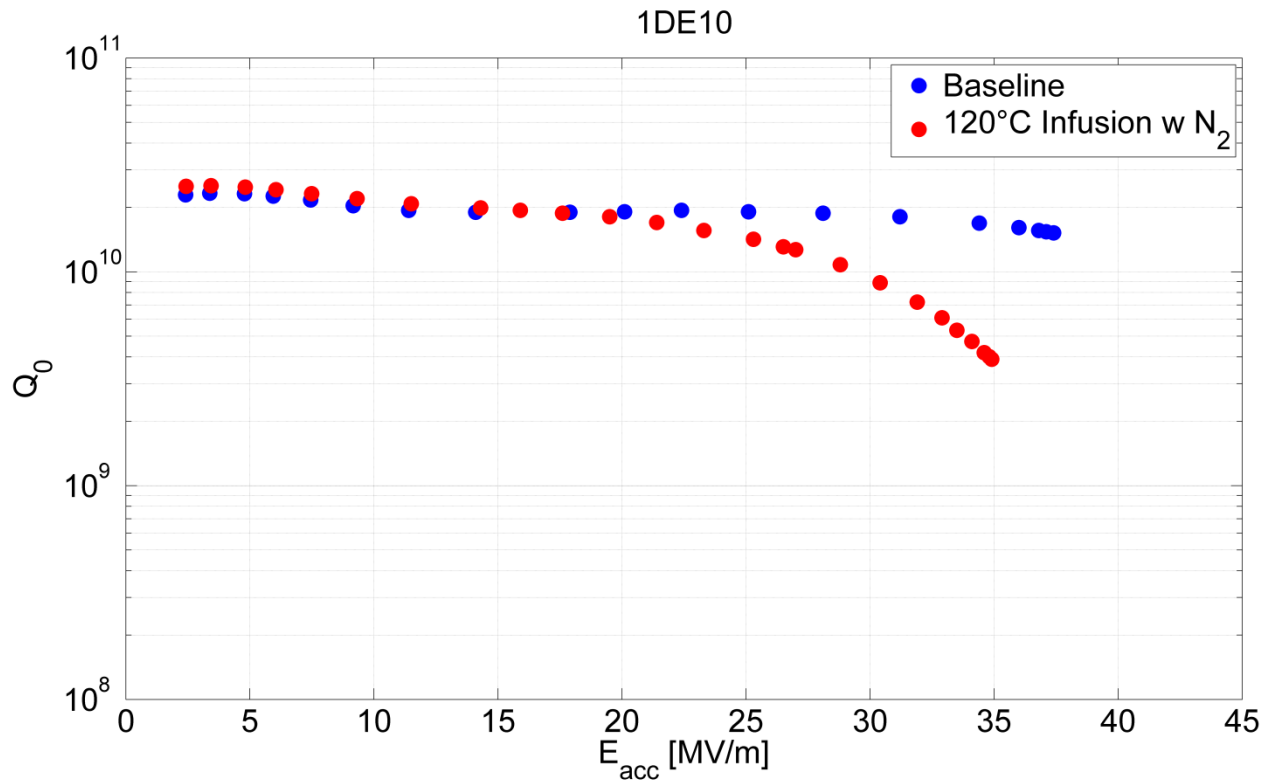
[K. Umemori et al., „Trial of Nitrogen Infusion and Nitrogen Doping by using JPARC Furnace“, THPB021@SRF2017]

KEK identified 120°C part of bake as origin of deterioration.

Did we solve our 800°C problem and moved on to another?

# Sixth and Seventh Infusion Run

With Nitrogen!



Again precipitates on samples! ☹

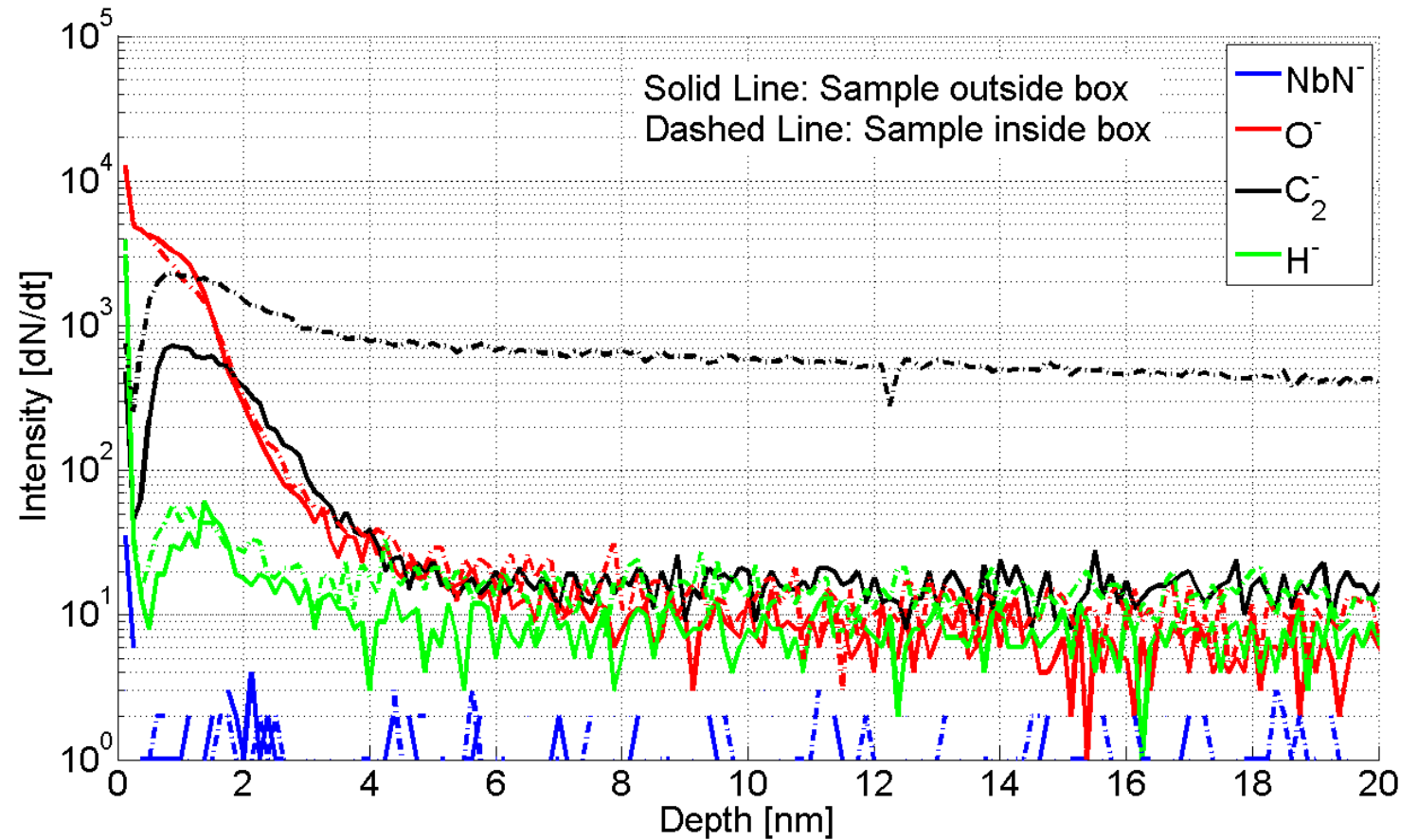
BUT...

# TOF-SIMS Analysis

Treated vs. Reference and „Inner vs. Outside Atmosphere“



No precipitates on outside samples  
Precipitates on inside samples



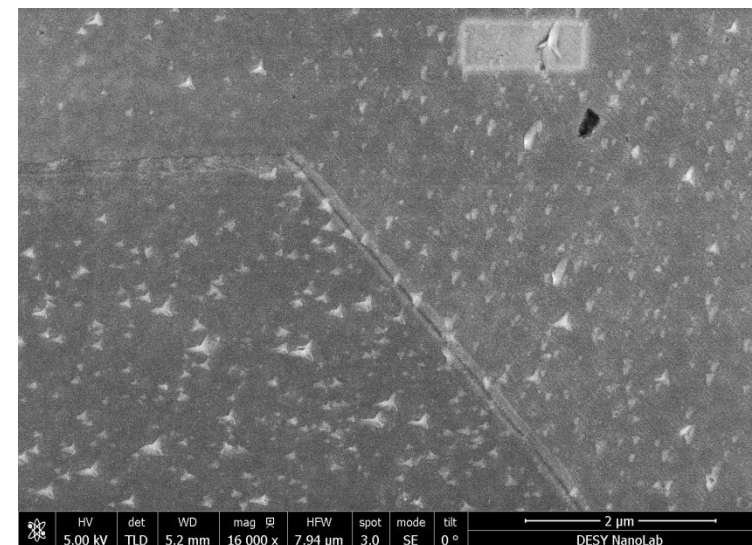
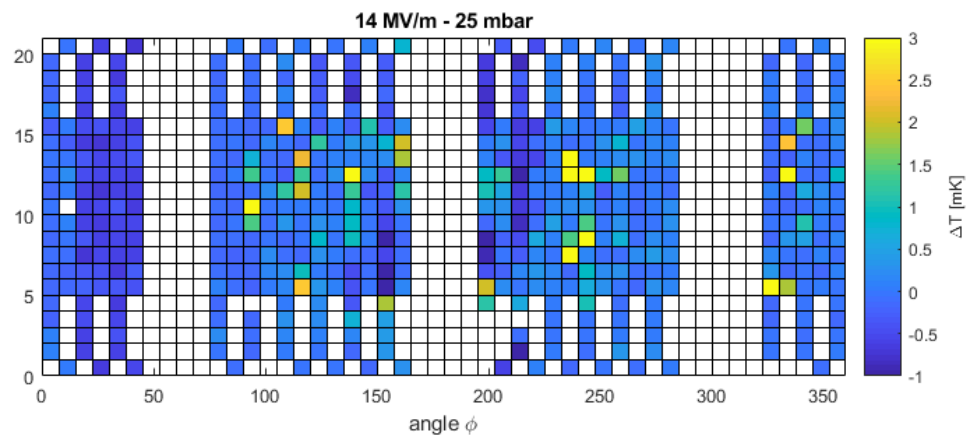
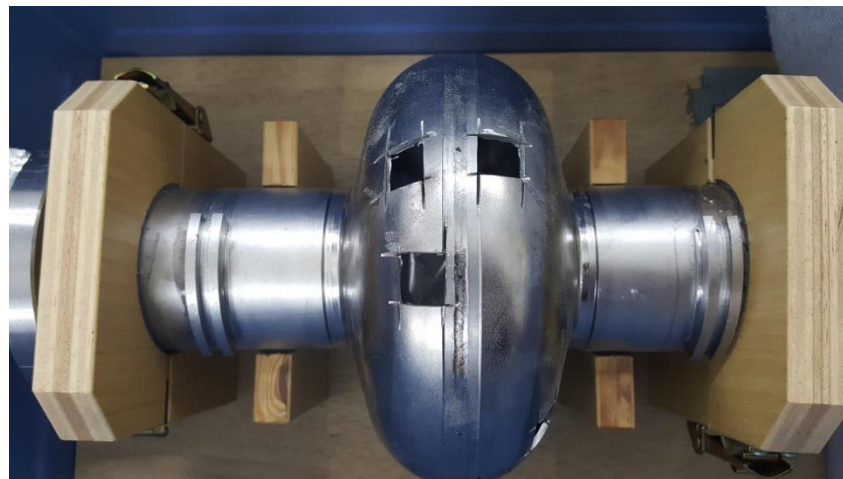
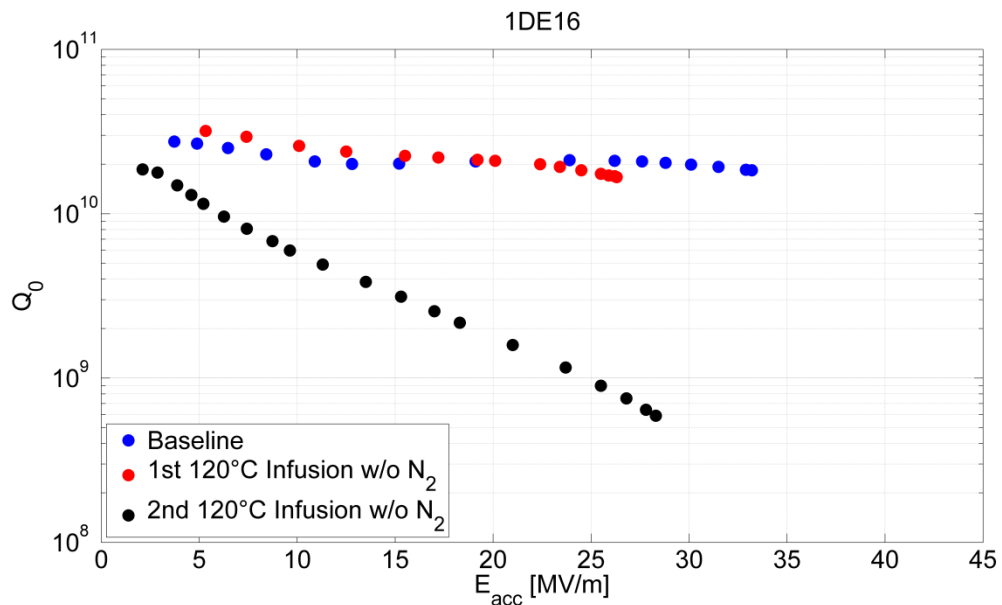
# Current Situation

- Repeated infusion on 1DE27 w/o resetting
  - Decision to do infusion at 160°C
  - VT took place two weeks ago – cold leak at 16MV/m ☹️
  - TOF-SIMS showed no NbN<sup>-</sup> signal in samples...
- Infused a new cavity 1DE7
  - Again 160° C
  - Disassembled on Monday – preparation for VT ongoing
- Assess recipe after 1DE7 VT and sample analysis



# Sample Surface = Cavity Surface?

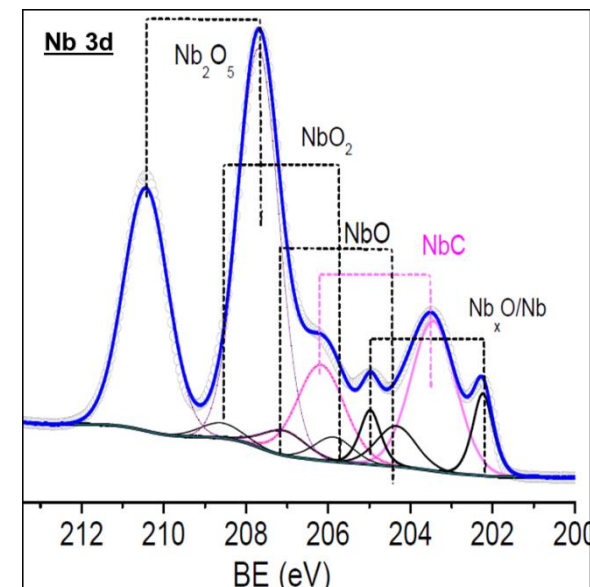
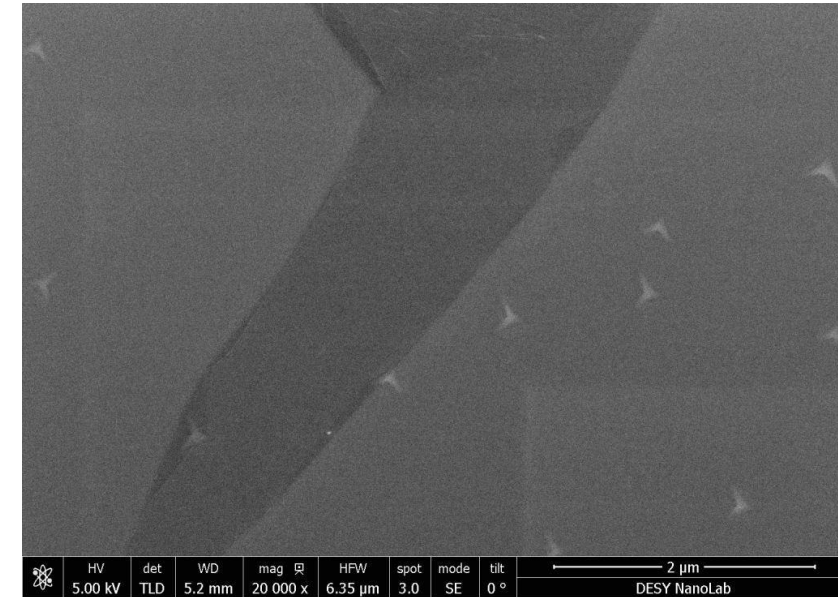
## Origin of deterioration?



# One more puzzle...

## In-situ sample R&D

- UHV-mobile chamber with in-situ surface characterization
- Two samples, both single crystals [100]:
  - Purified by degassing at 2000°C in UHV
  - „Cavity grade“ material from large grain disc
- Both baked at 800°C in UHV for 2h & 120°C for 48h with 0.03 mbar N<sub>2</sub>
- Cavity grade material showed precipitates - purified sample did not!
  - SEM
  - XPS confirmed Nb-C phase, no Nb-N





# Conclusions

- „Atmosphere“ inside cavity and niobium box different than furnace – no data!
- Need of caps will be investigated
- New set of caps with defined „leak“ will be fabricated
- Lack of nitrogen in samples is puzzling
- Origin of Nb-C precipitates
- And relation to rf performance not obvious

