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New insight on the N-infusion effect in Niobium

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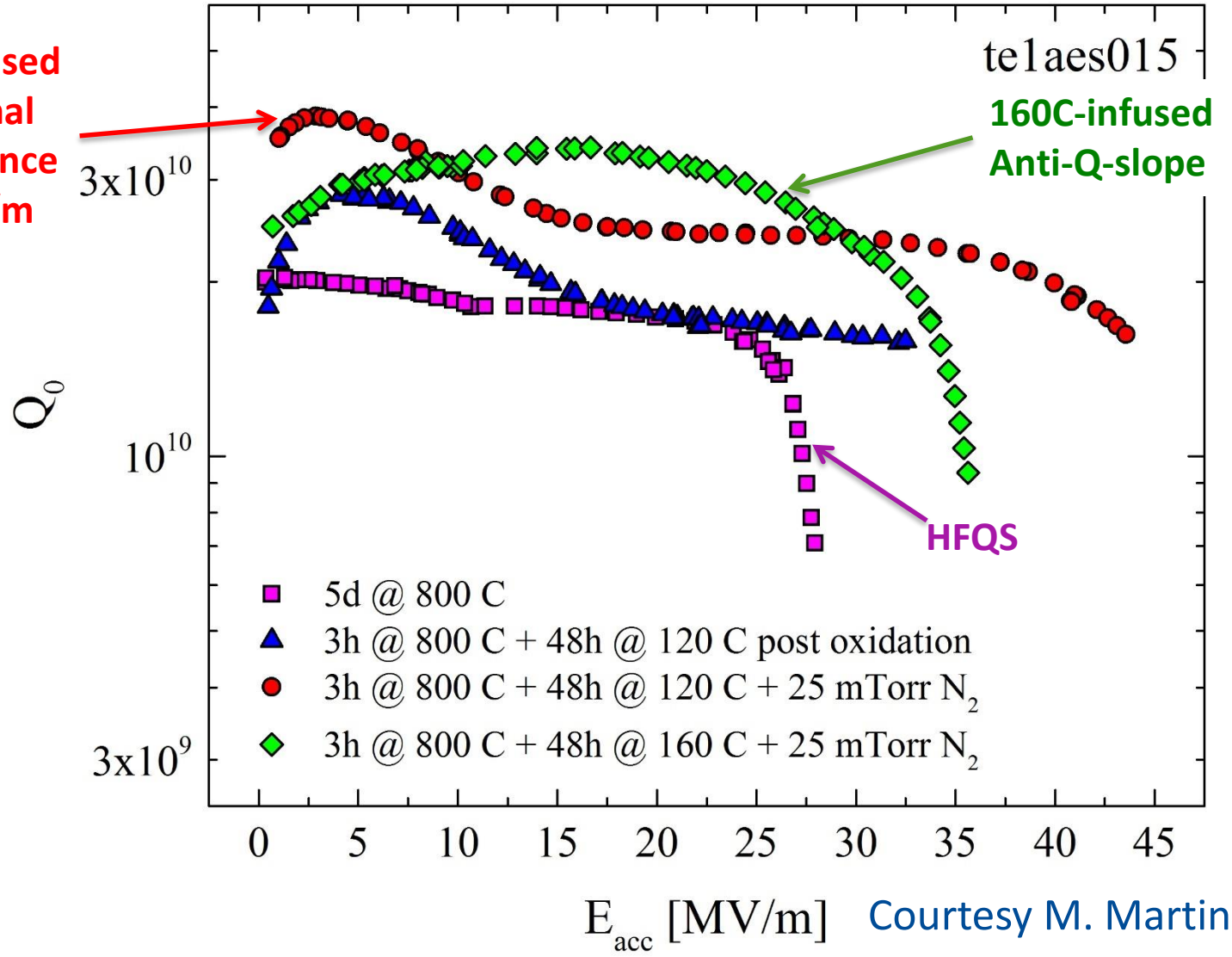
Effect of N-infusion on performance



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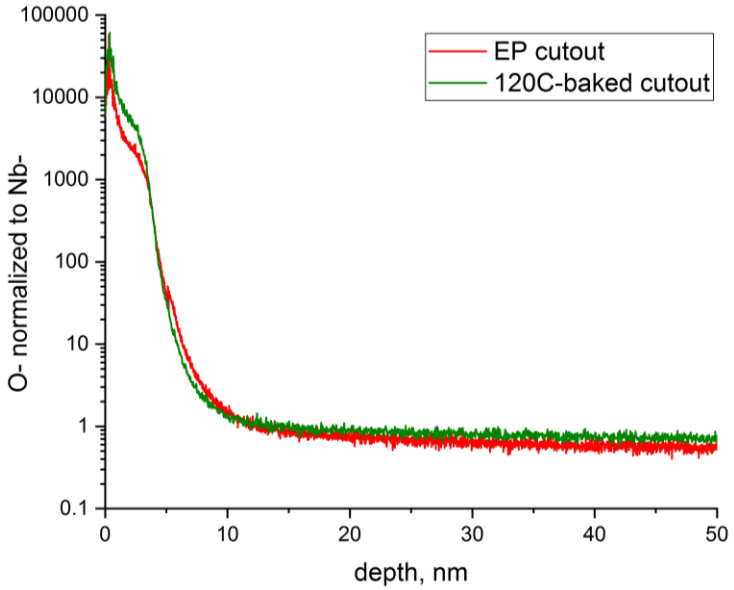
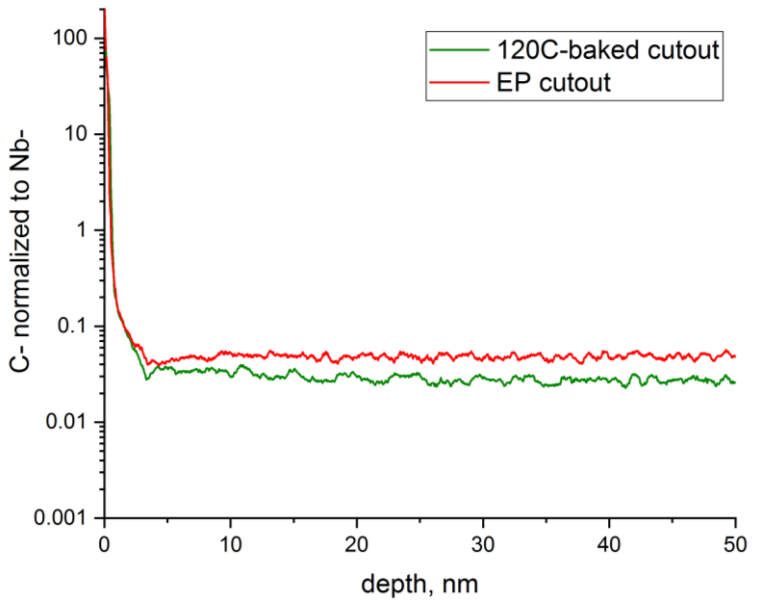
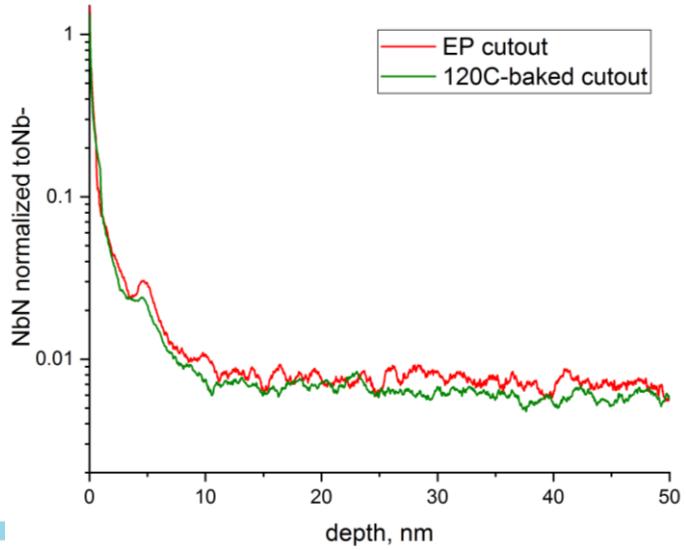
SIMS on cavity cutouts



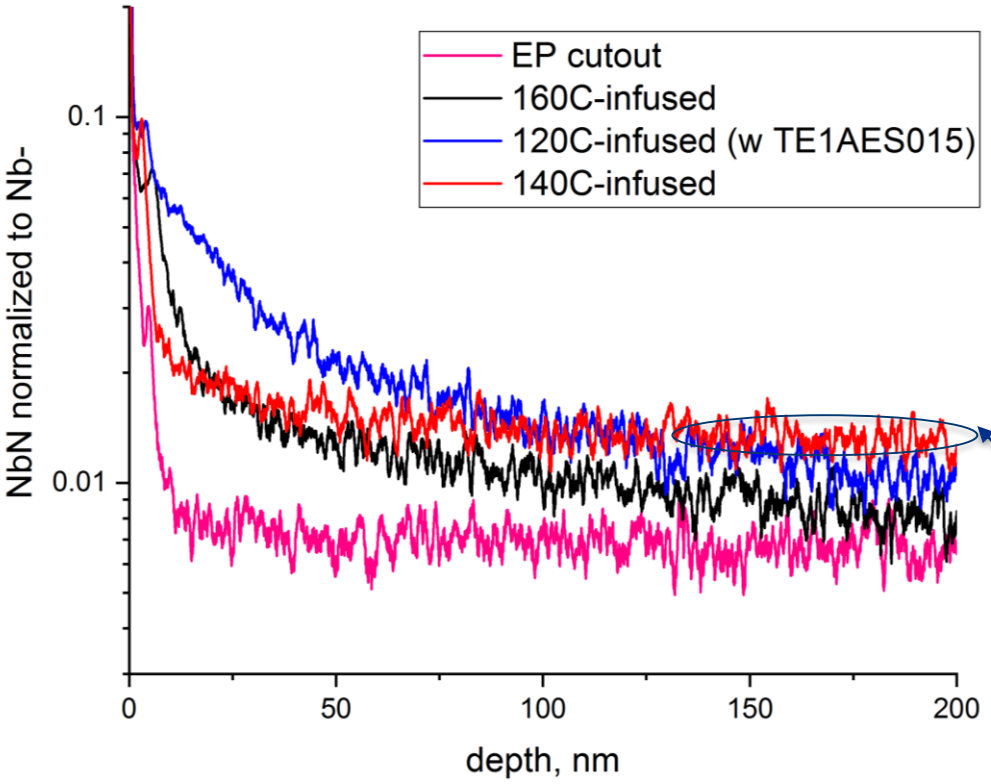


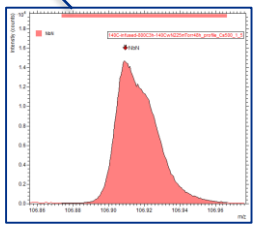


- O, C and N signals are similar in EP and 120C-baked cutout
- 120C bake doesn't change O concentration
- No role in HFQS removal

SIMS Nitrogen profiles of infused samples*

**All the infusion data was taken from the samples that reproduce or witness the treatments in the same furnace as cavities.*

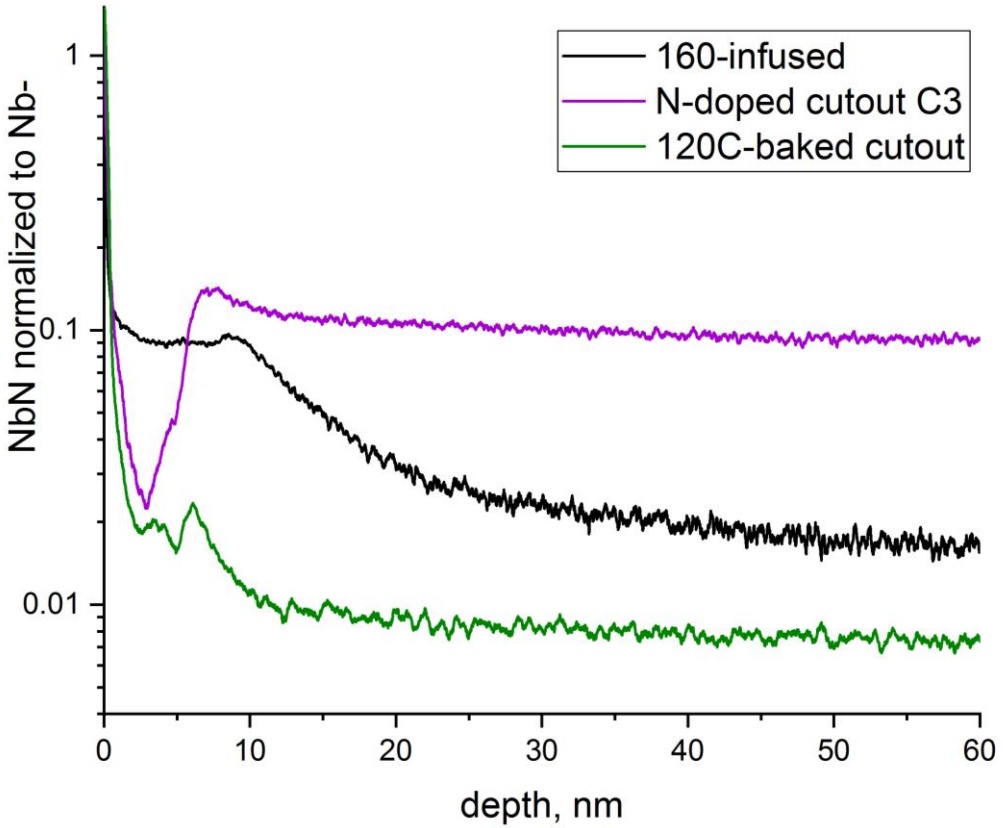




Mass interference in 140C-infused

- N-infusion modifies the RF the surface
- Nb oxides/Nb interface is affected by Nitrogen

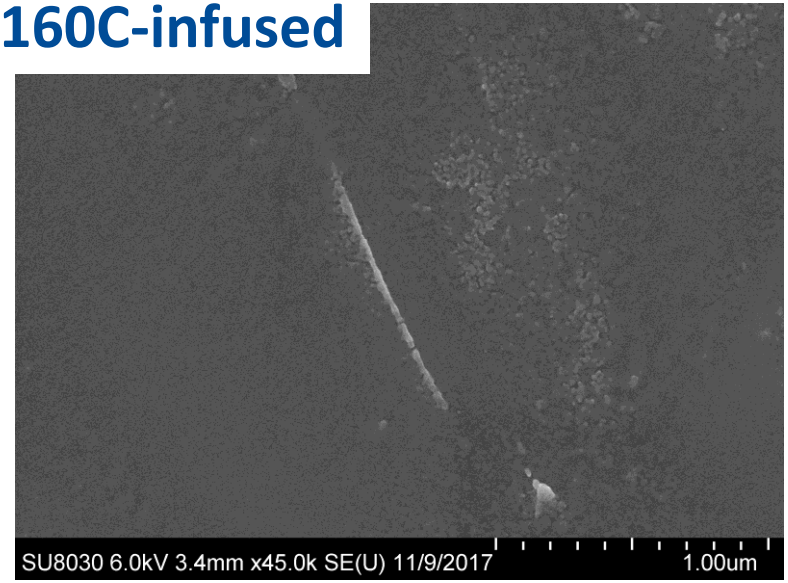
N-infusion vs N-doping

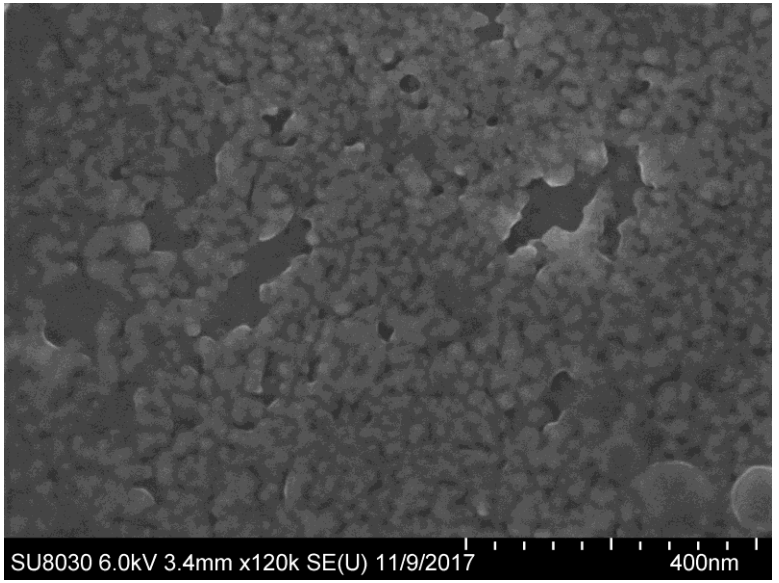


- N-doped shows highest N_2 intensity comparing to infused samples

Surface features of infused samples

160C-infused

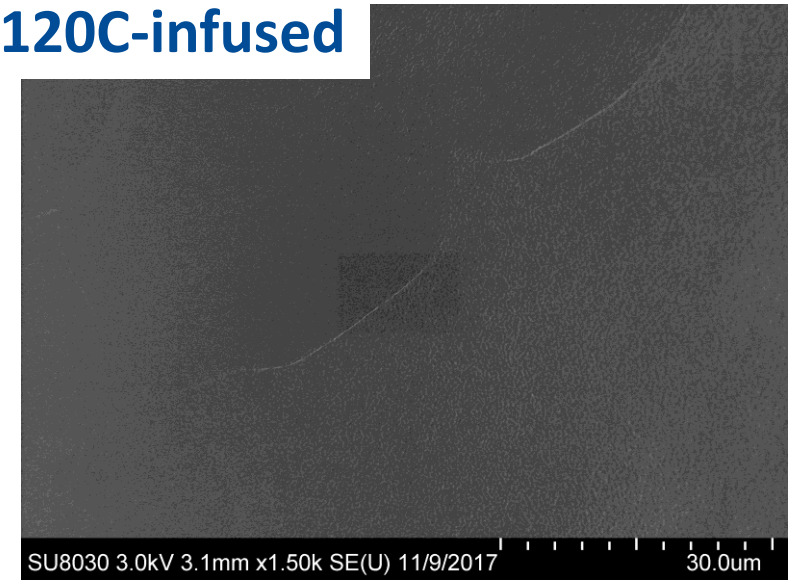


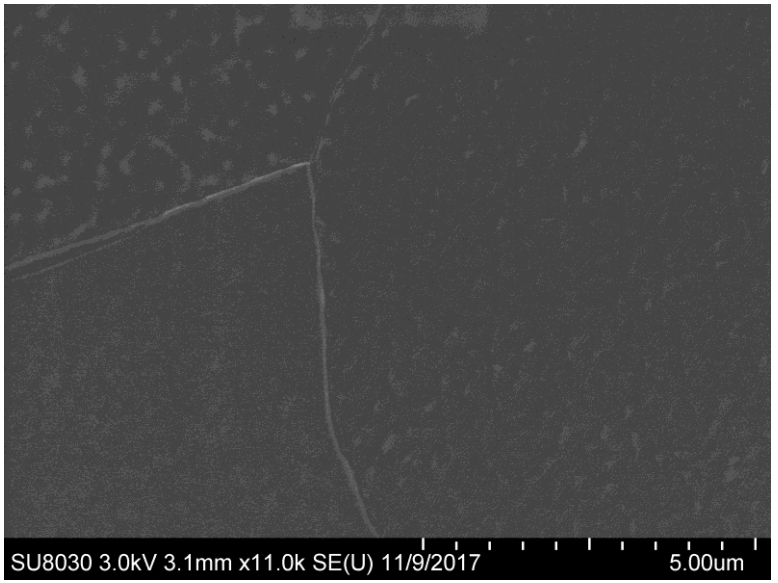


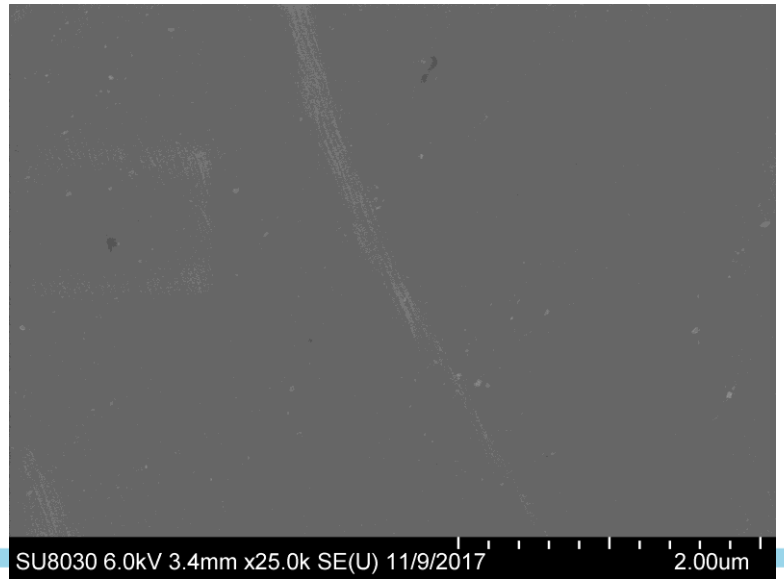
- Small features on 160-infused surface
- Features are slightly charging during SEM imaging.
- Oxygen-related features? Work in progress.

Surface features of infused samples

120C-infused

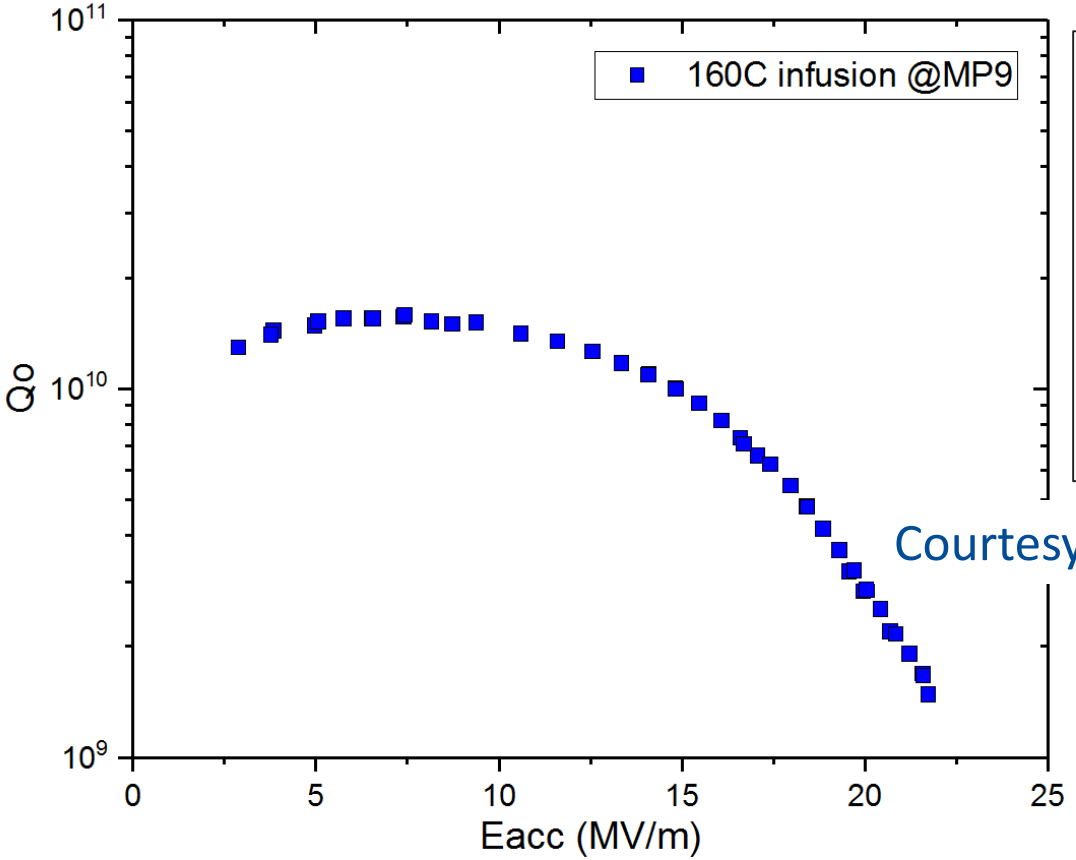


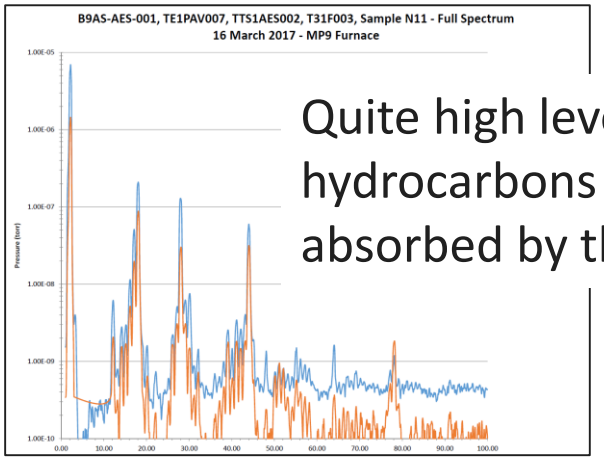




- Small modifications of the surface

Furnace contamination effect on infusion





Quite high level of hydrocarbons may be absorbed by the cavity

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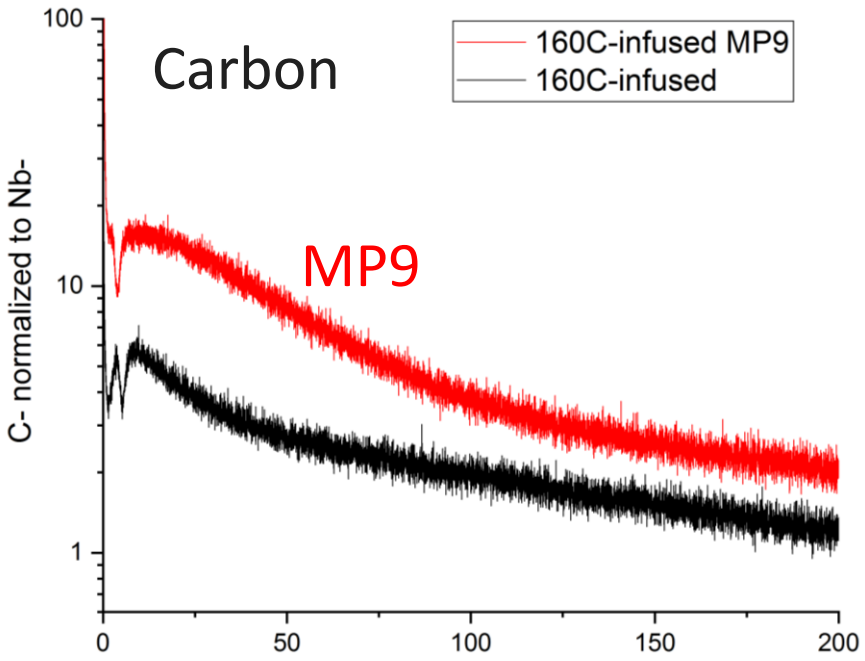
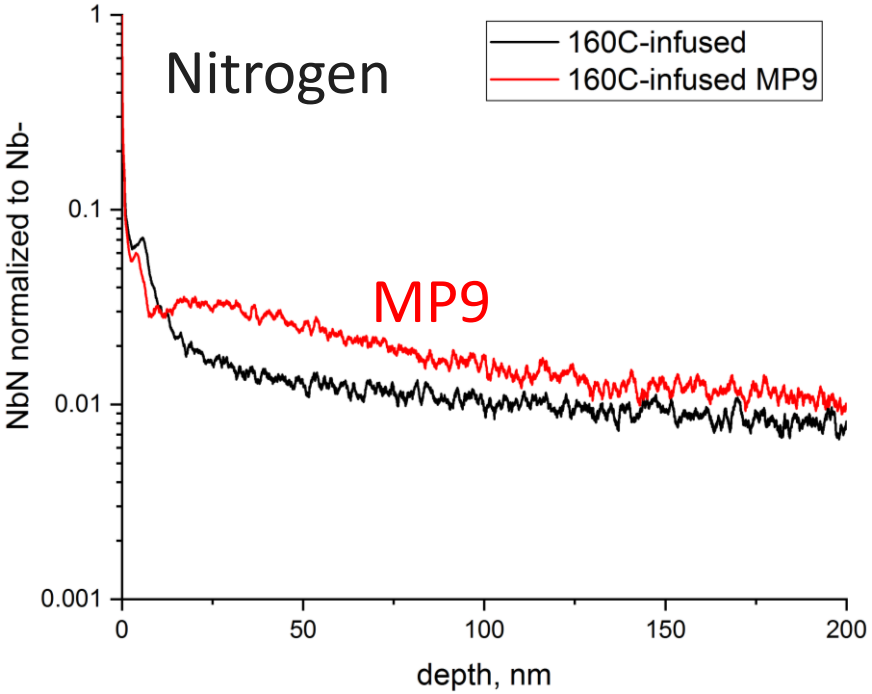
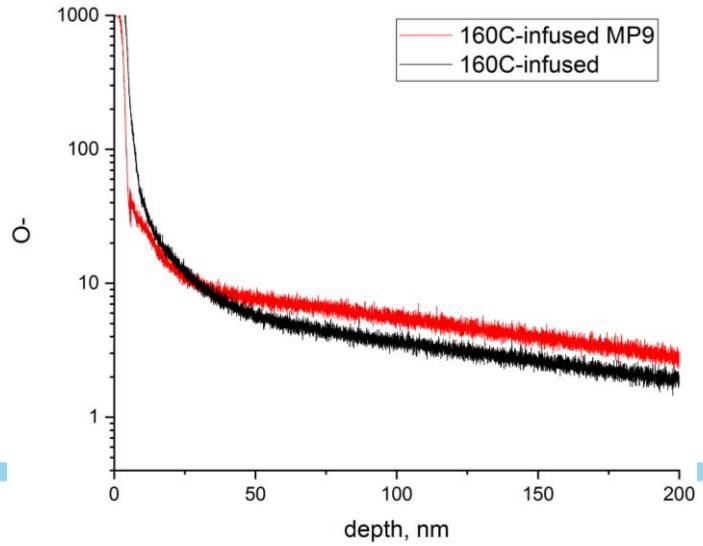
- Carbon-related contamination is detrimental

Contaminated sample from MP9 furnace







- Too much Carbon even Nitrogen signal is similar
- Oxygen signal is identical in “bad” and “good” samples

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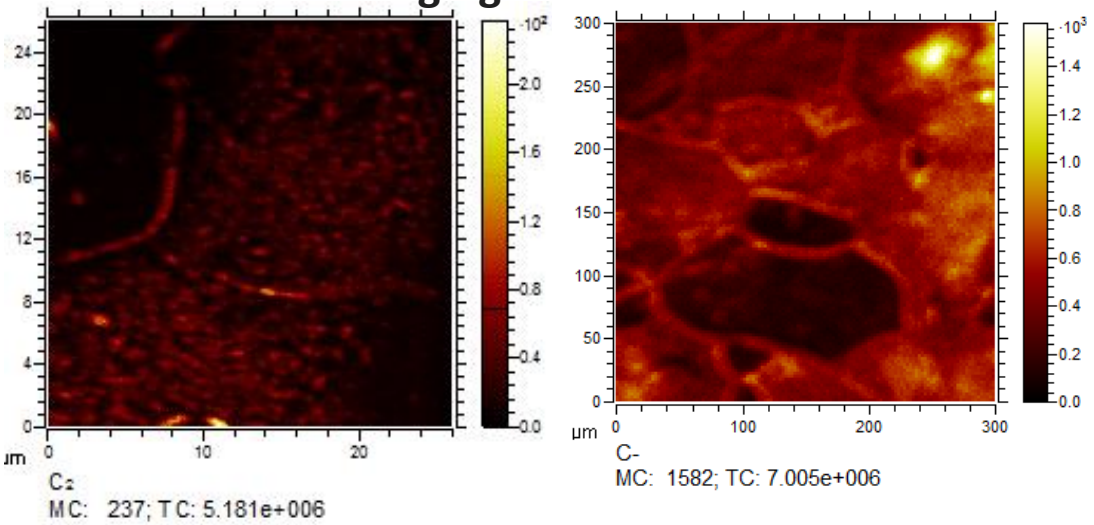
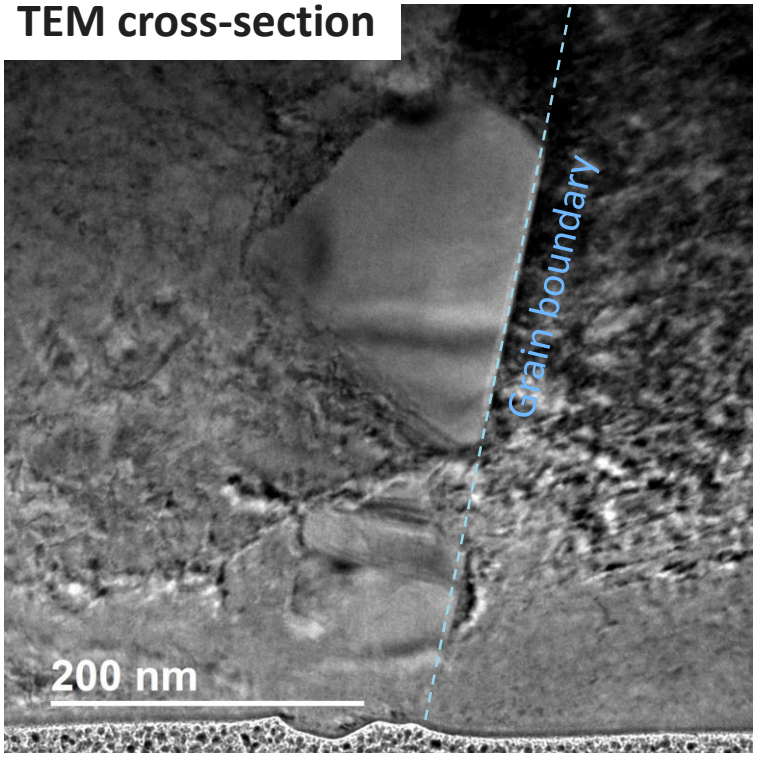
Carbon contamination in infused samples

SIMS chemical imaging



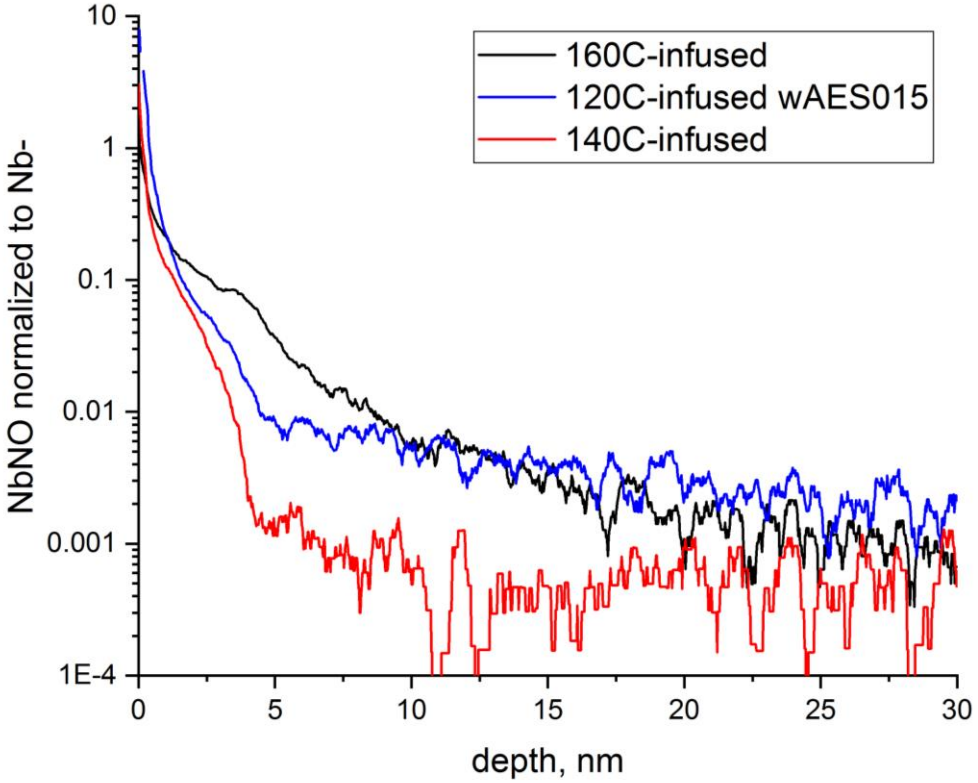
TEM cross-section



SEM imaging

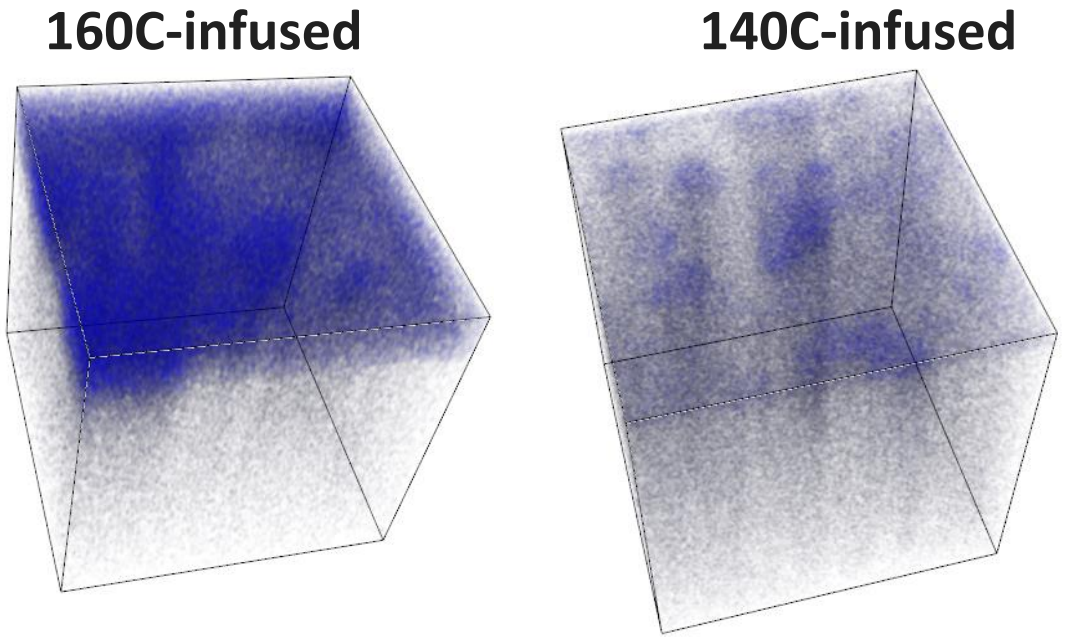
- Carbon is prominent at the grain boundaries

N-related ion signals in infused samples



- NbNO- signal (can be related to oxynitrides) is higher, possibly deeper in 160-infused sample.

3D visualization of Nitrogen intensity



- NbN- signal intensity is reconstructed from the data with identical parameters.
- Nitrogen signal intensity varies for different Nb grains.

Conclusions

- N-infusion enables unprecedently high Q and high gradient in Nb cavities.
- N-infusion introduces Nitrogen into the first hundred nm of the surface.
- Furnace contamination can be detrimental for the infusion: higher level of C is detected in the witness sample for not successful infusion run.
- Infusion samples studies will be continued to understand the details.

Thank you!