# Task 9.3 : 6 GHz Cavity deposition

Aim: Evaluation of SRF performance of high Tc superconductor thin film by deposition of high Tc superconductor inside a 6 GHz copper cavity.

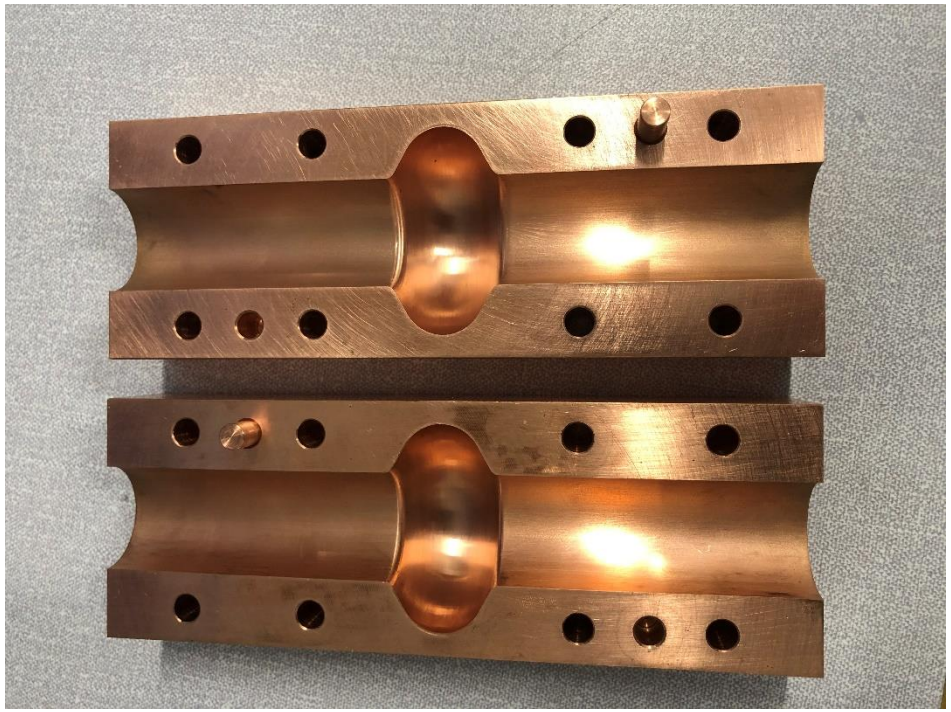
Nb3Sn, NbTiN, NbN, MgB2

# Cavity Coating and Evaluation

# 6 GHz  copper cavity

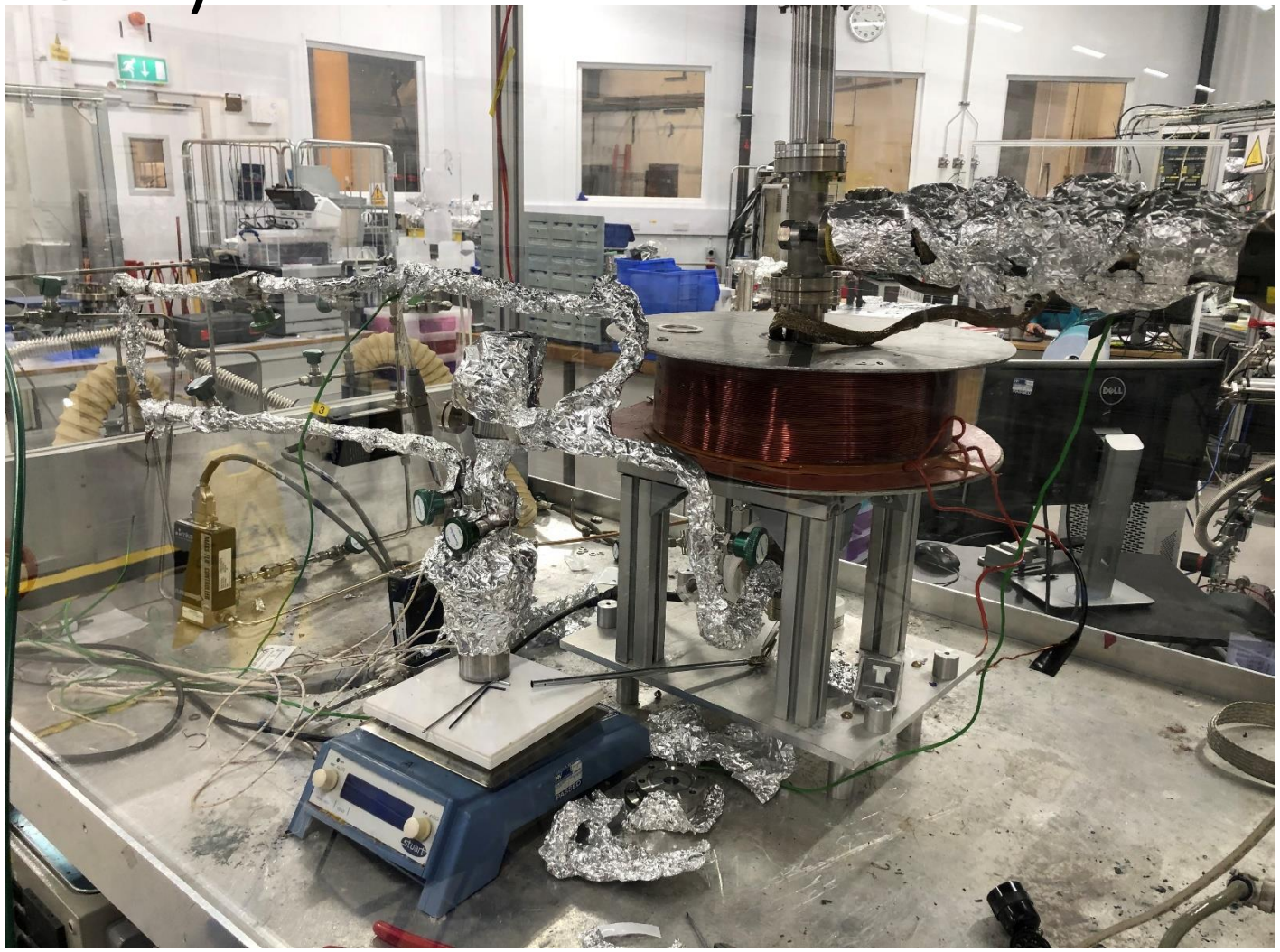
Two type  of cavity is going to be explored at STFC

INFN seamless standard elliptical copper cavity



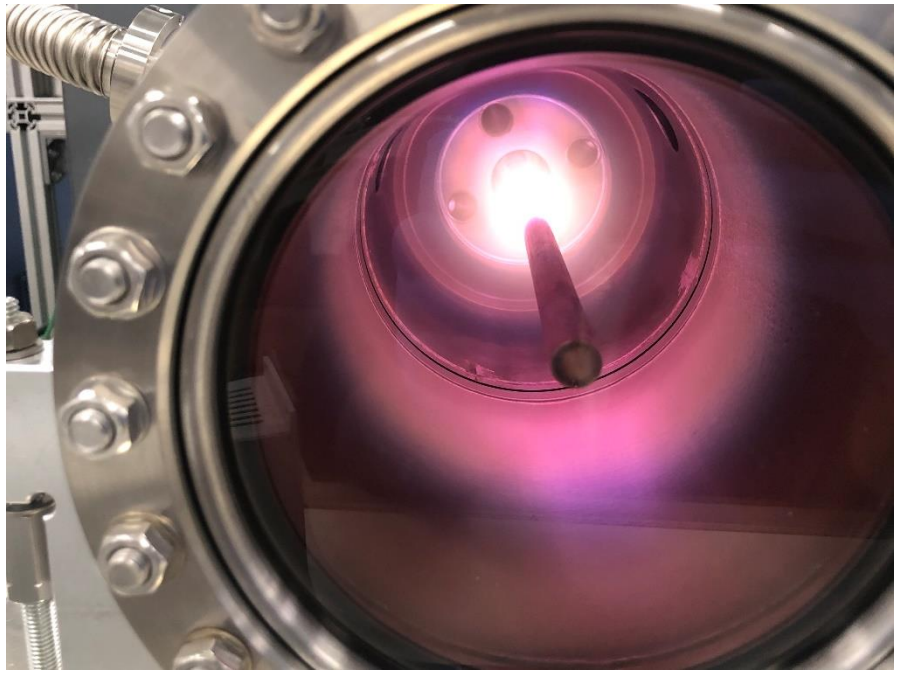
Lancaster University / STFC spilt cavity design

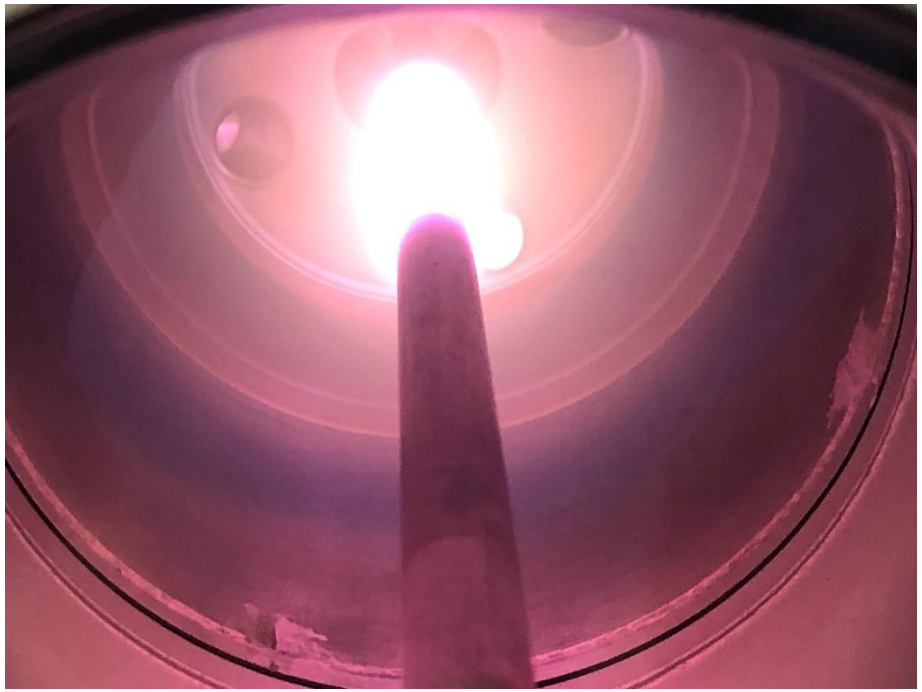
# Deposition facilities: Hybrid physical chemical vapour deposition (HPCVD)



- Single or twisted multiple wires with outer magnetic field.

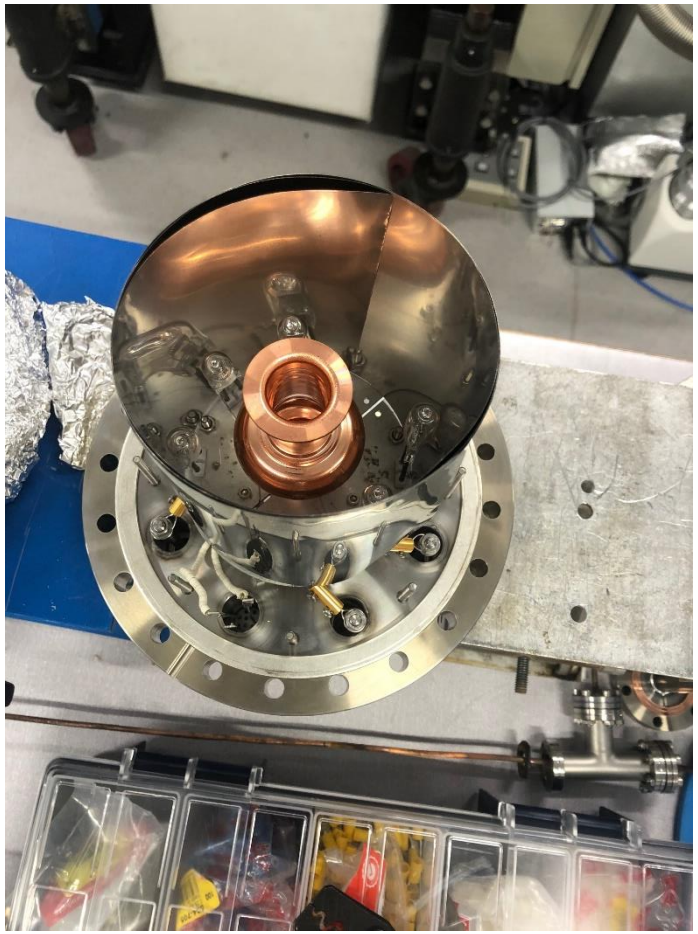
# Permanent Magnet  Cylindrical Magnetrons

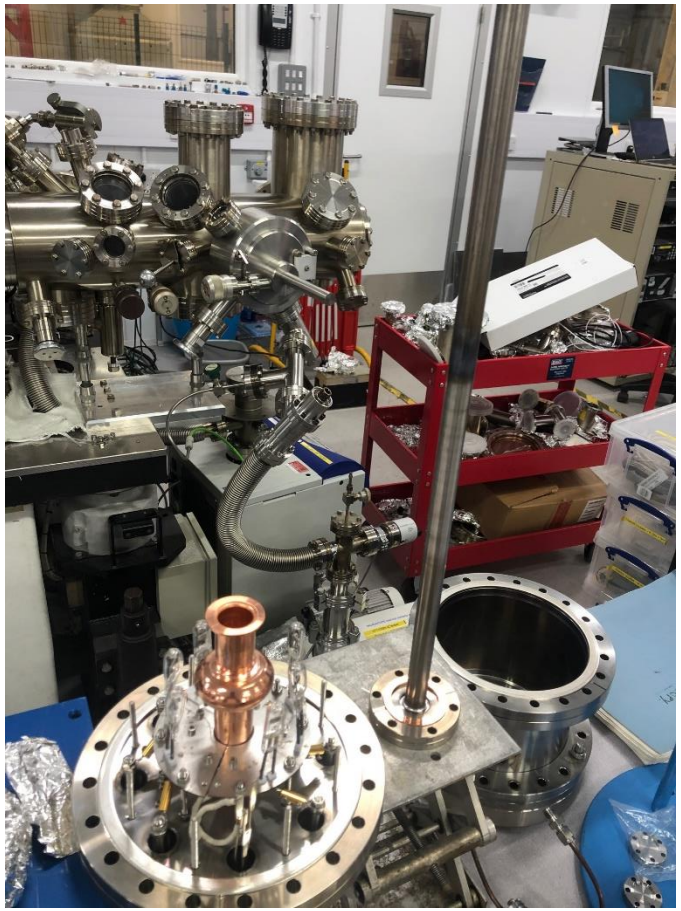




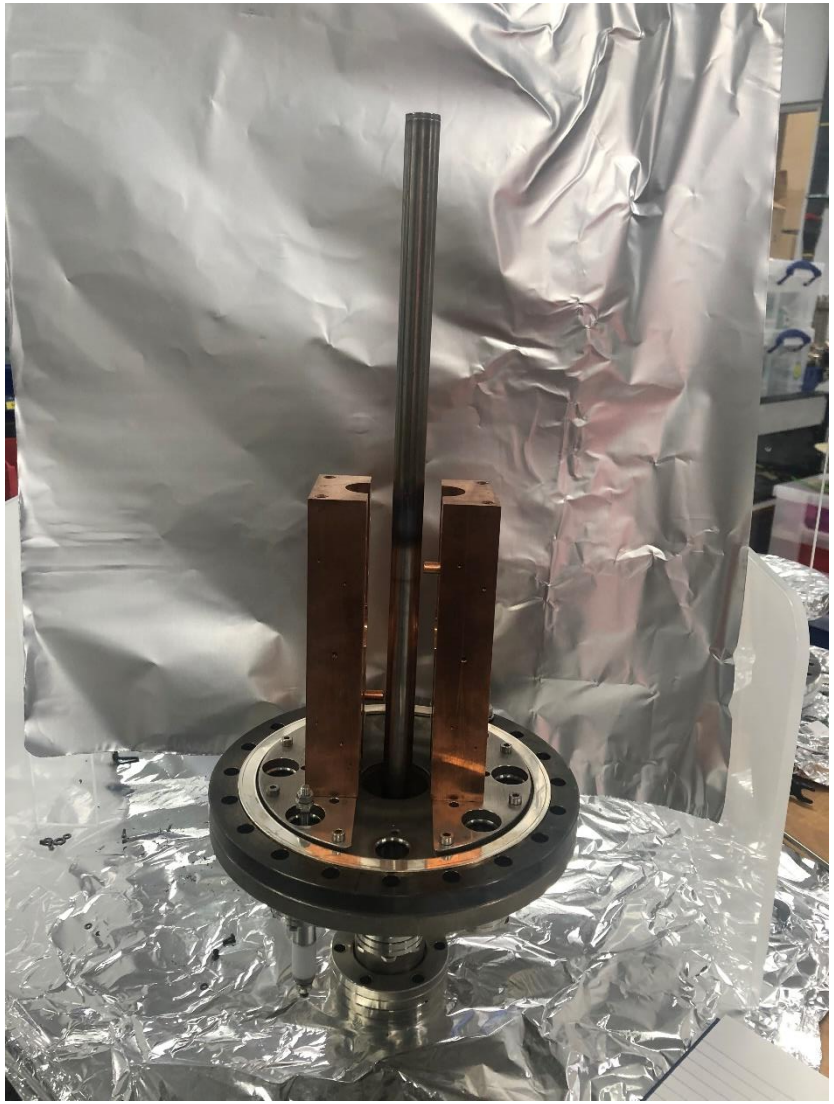
- Two niobium cylindrical magnetrons with water cooled  internal permanent magnet  are manufactured (19 mm and 13 mm OD) which were tested and ready to be implemented.

# 6 GHz cavity mount for deoposition

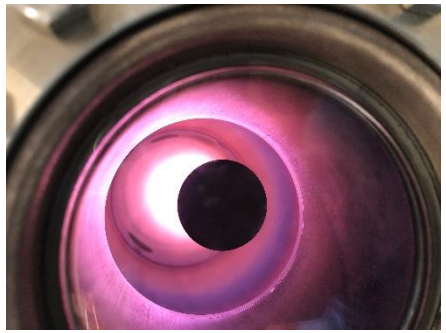




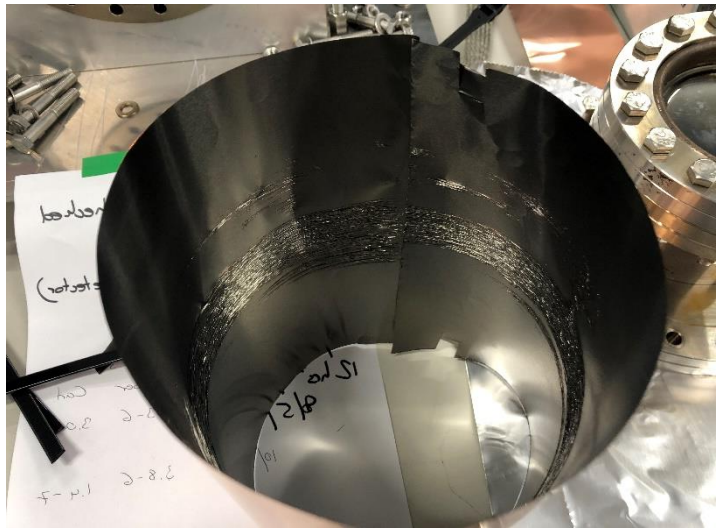
# Open 6 GHz Cavity assembly with Magnetron



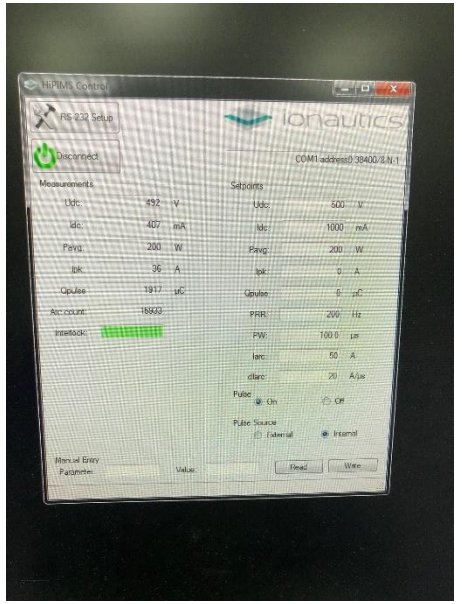
# Large cylindrical Magnetron

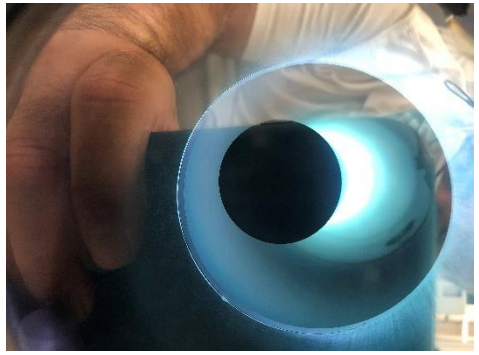


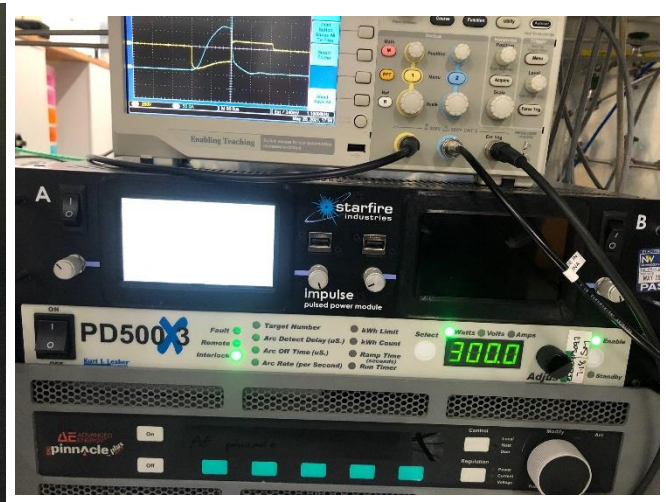
DC and pulse DC sputtering

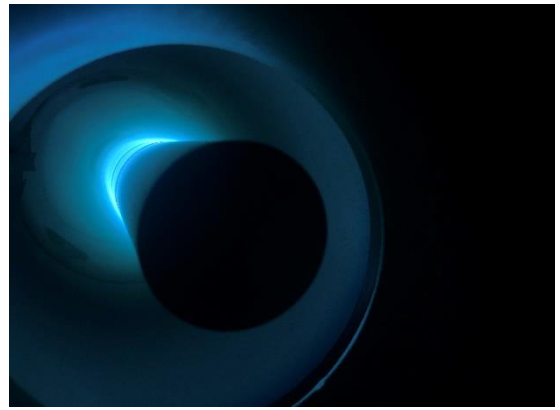


Film deposited along the length of active magnetron area. Some condition the centre delaminated





Various HIPIMS supplies with + kick and no bias

# Planar Samples
# &
# QPR deposition

# Task 9.3 part Two

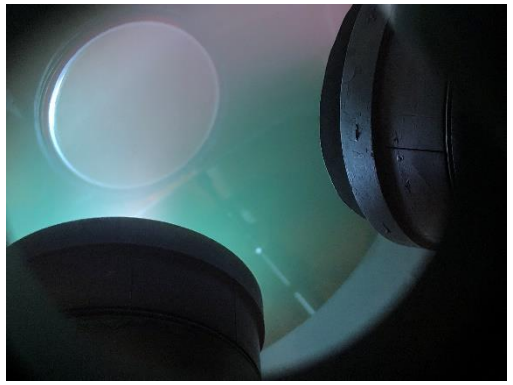
- Aim: optimise deposition parameters for other high Tc superconductor and provide sample for other partners for SRF evaluation of the SRF thin Films

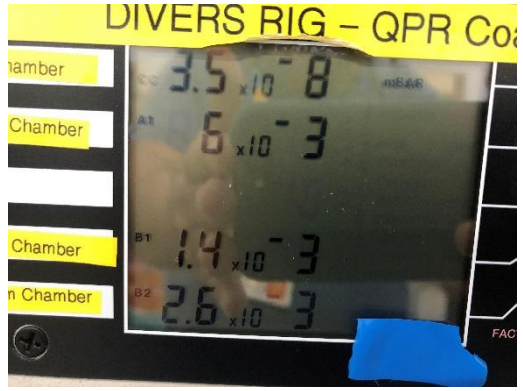
# QPR Deposition Nb/AlN/NbN

Nb Layer:
Power: 400W Pulsed DC
Current: 1.54 A Voltage: 260 V
F: 350 KHz and DT: 1.1 µs
Time: 5.5 hours
Thickness: 4 µm
Gas: Kr Pressure: $2x10^{-3}$ mbar

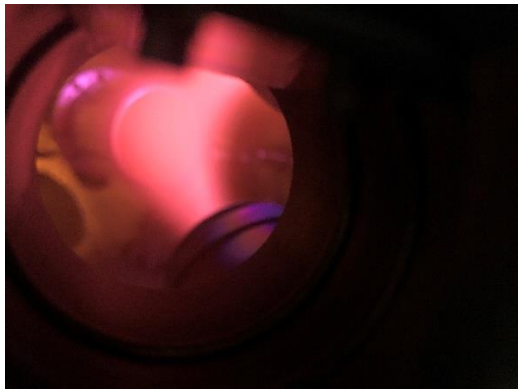
AlN Layer
Power: 200 W Pulsed DC
Current: 0.56 A Voltage: 357 V
F: 350 KHz and DT: 1.1 µs
Time: 1.5 min
Thickness: 3nm
Gas: Kr/N2 Pressure: $3.6x10^{-3}$ mbar

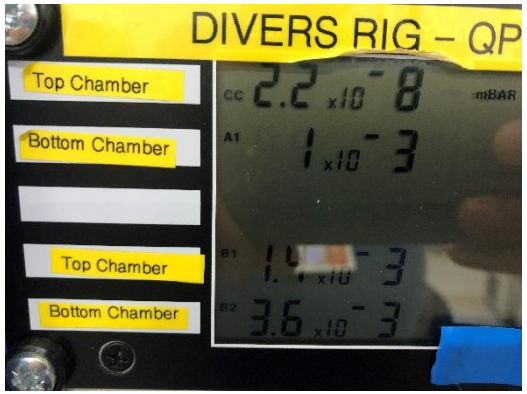
NbN depositon:
Power: 300W Pulsed DC
Current: 0.67 A Voltage: 449 V
F: 350 KHz and DT: 1.1 µs
Time: 40 min
Thickness: 180 to 200 nm
Gas: Kr/N2 Pressure: $3.6x10^{-3}$ mbar

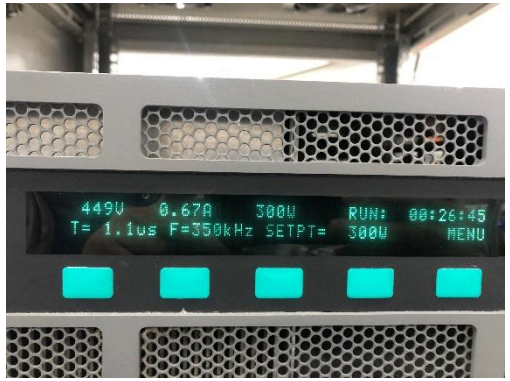



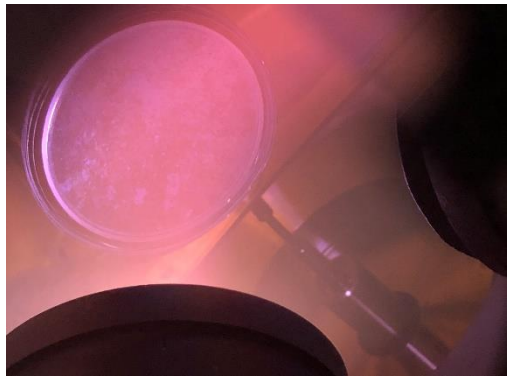


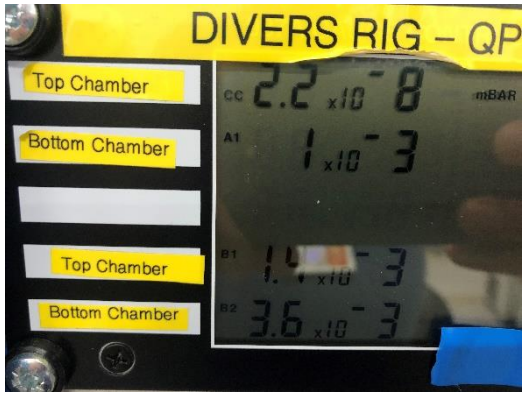




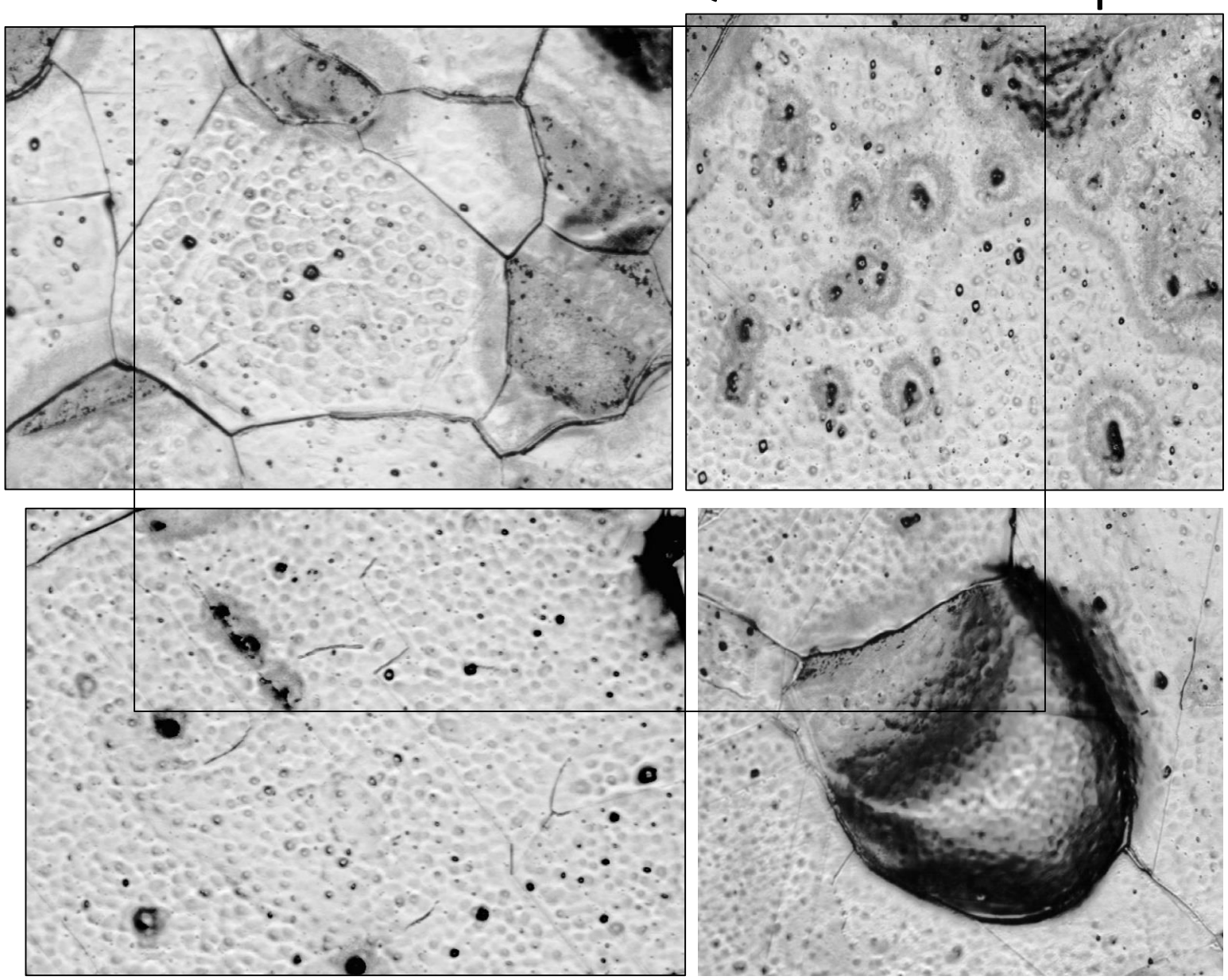


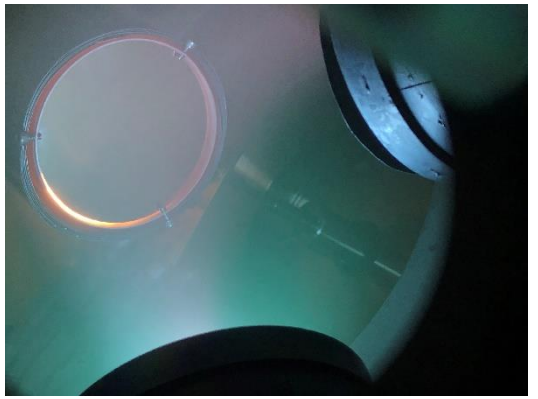


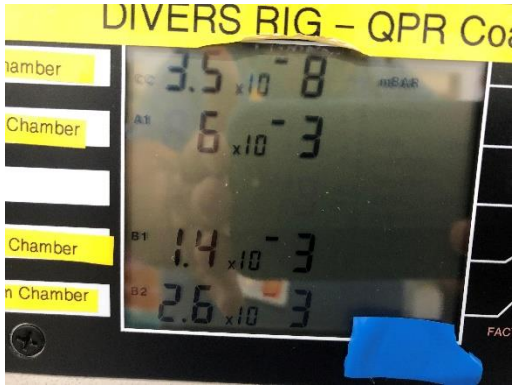
# QPR after deposition



# Diamond turned Cu Nb/AlN/NbN

Nb Layer:
Power: 400W Pulsed DC
Current: 1.69 A Voltage: 237 V
F: 350 KHz and DT: 1.1 µs
Time: 5.5 hours
Thickness: 4 µm
Gas: Kr Pressure: $2.6 \times 10^{-3}$ mbar

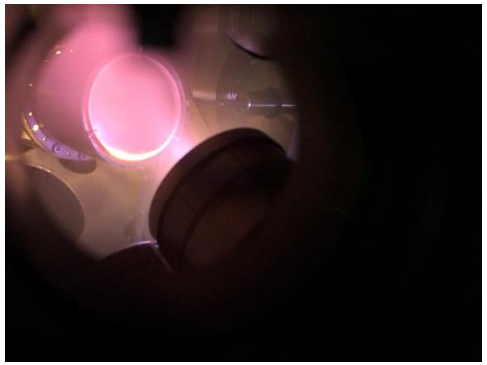





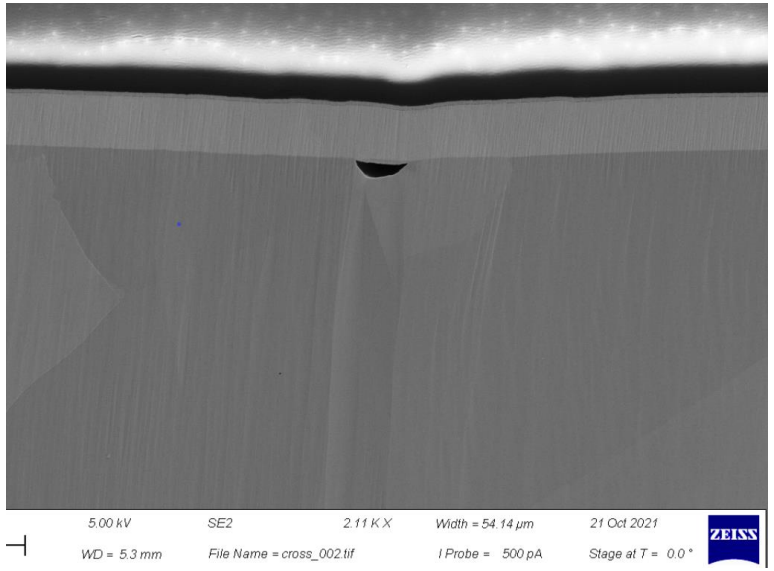

AlN Layer
Power: 200 W Pulsed DC
Current: 0.56 A Voltage: 357 V
F: 350 KHz and DT: 1.1 µs
Time: 1.5 min
Thickness: 3nm
Gas: Kr/N2 Pressure: $4.3 \times 10^{-3}$ mbar

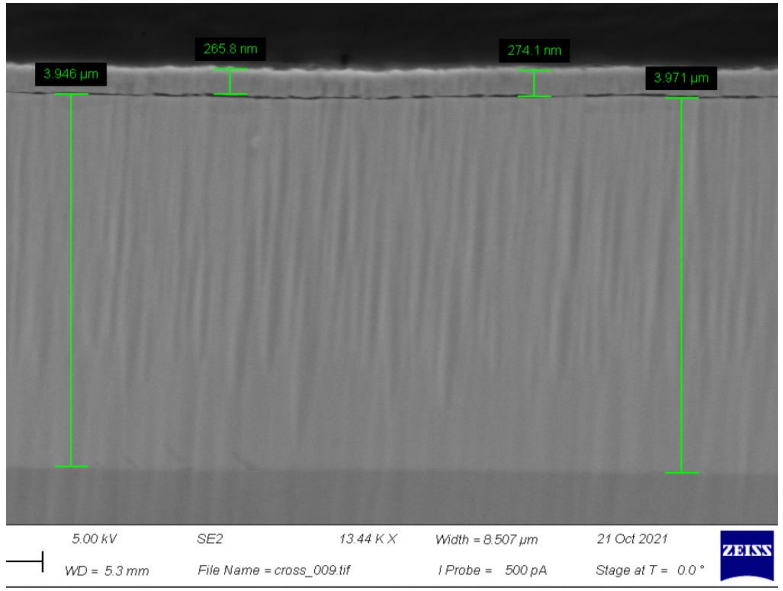


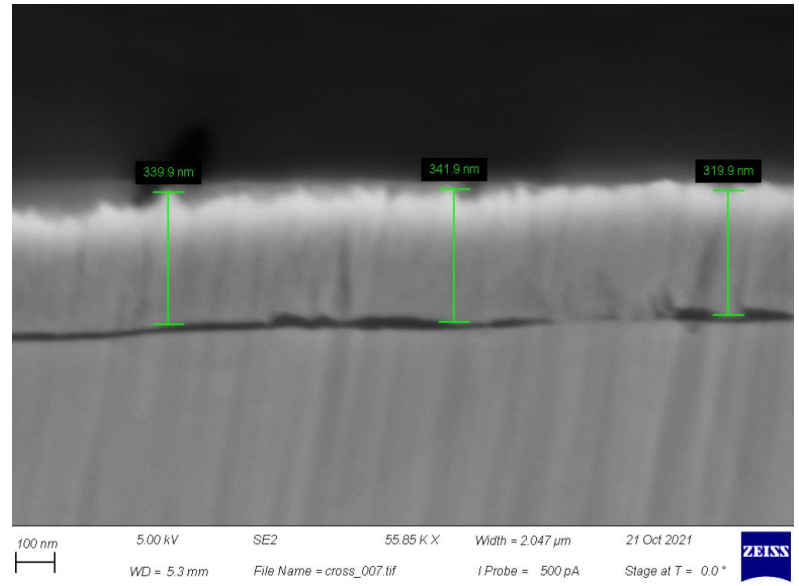
NbN depositon:
Power: 300W Pulsed DC
Current: 0.77 A Voltage: 392 V
F: 350 KHz and DT: 1.1 µs
Time: 1h 20 min
Thickness: 180 to 200 nm
Gas: Kr/N2 Pressure: $4.3 \times 10^{-3}$ mbar

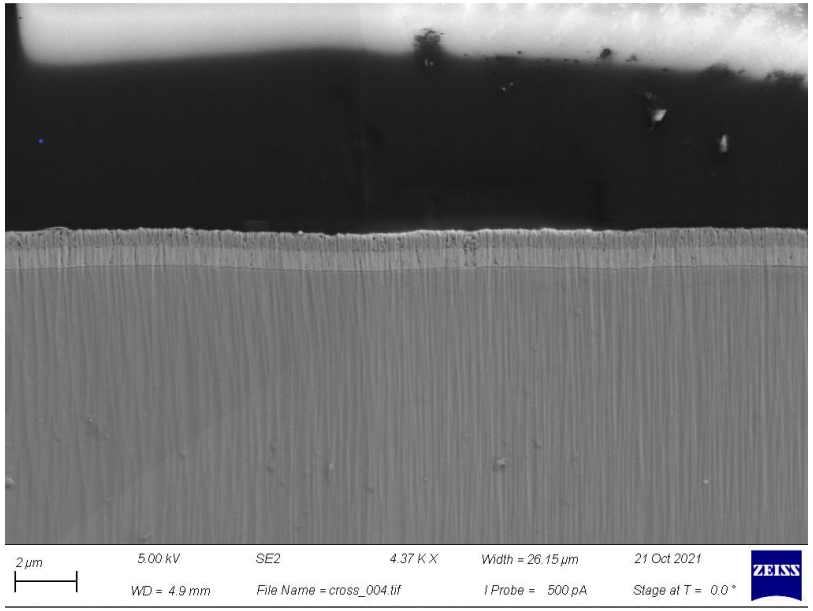



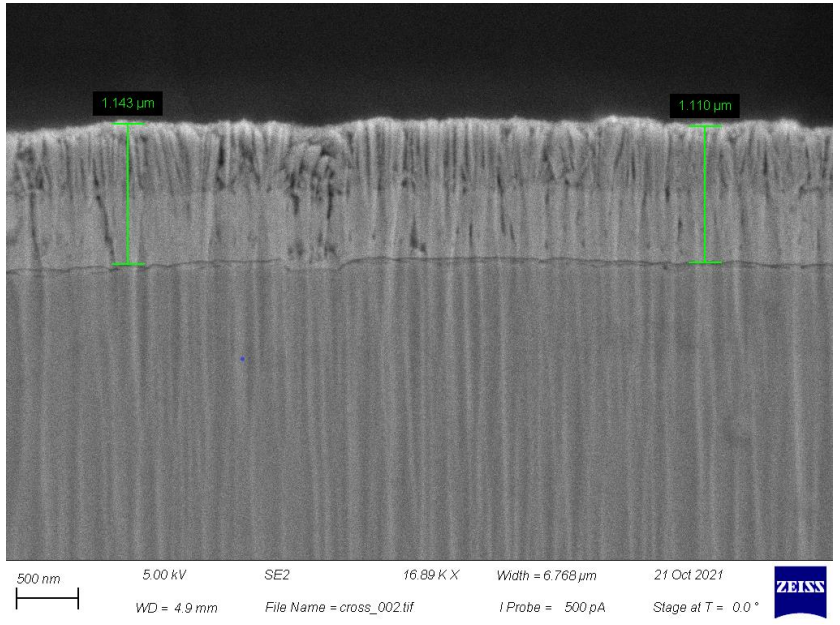
# Cross section SEM of triple and double Layer NBN

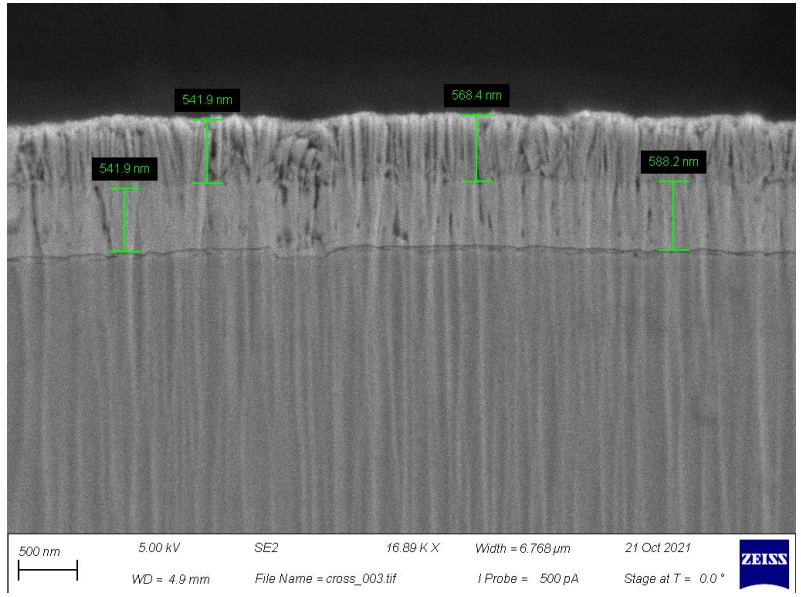


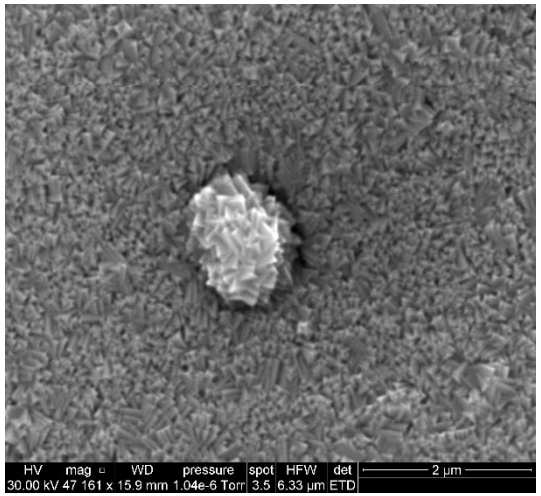



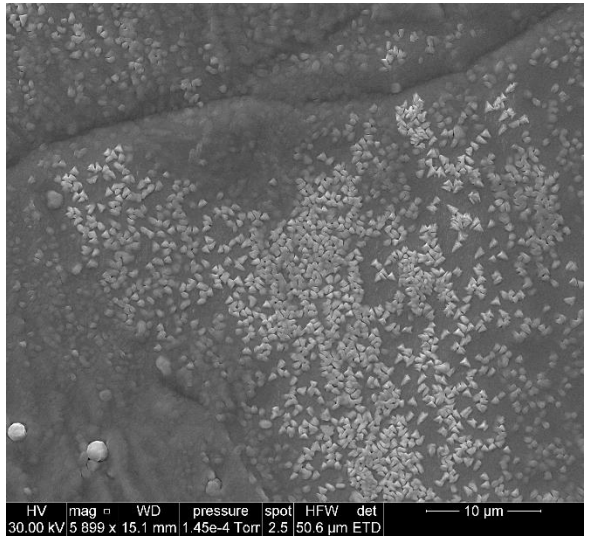



# SEM and EDS

Addition of SEM with EDS analysis to increase our efficiency

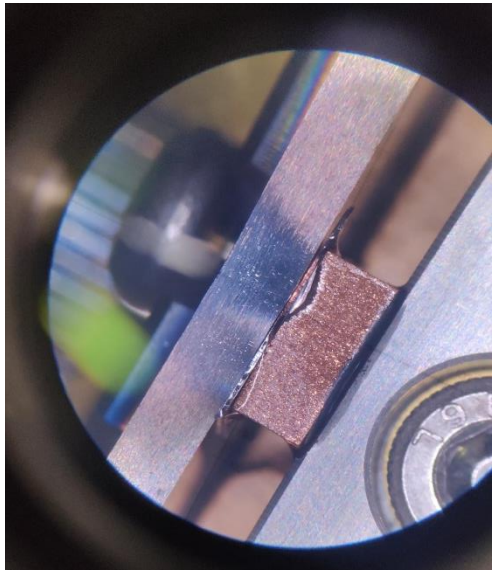



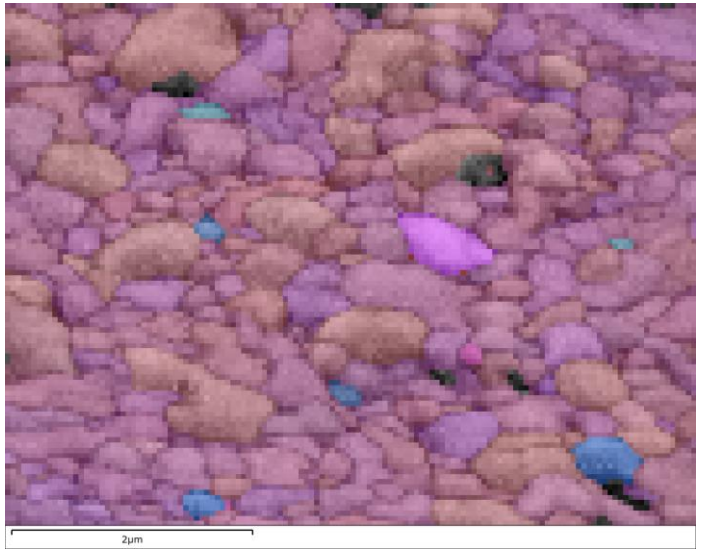

HIPIMS Multilayer Nb/NbN

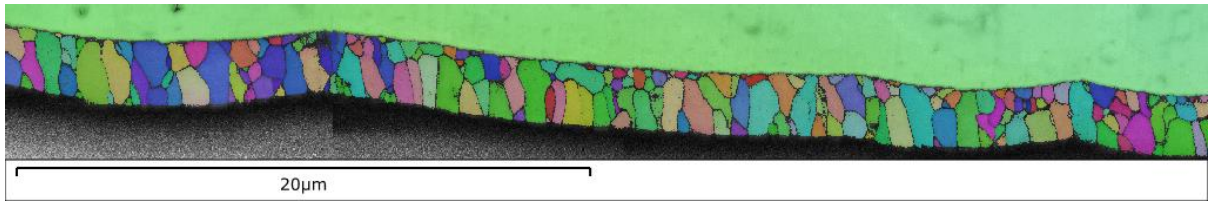


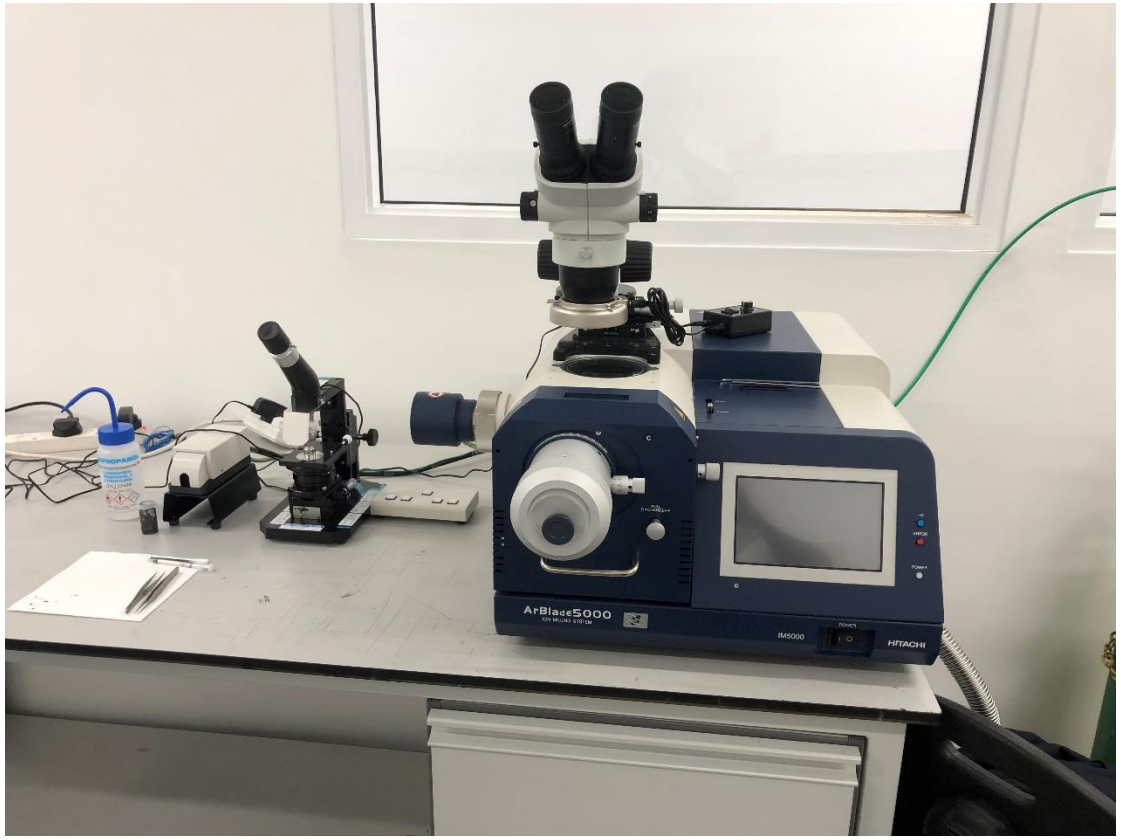

HIPIMS Nb

# Ion Beam Miller for X-section SEM and EBSD






Nb/AlN/NbTiN where the copper has been annealed at 650 C the top two layer is to thin to be resolved by EBSD.
EBSD is done at University of Liverpool

# Examples: Multi-layers

## Detailed EBSD of Nb section