

Surface treatments at CERN

M.Taborelli on behalf of the TE-VSC-SCC section

- Service and R&D activity
- Located at
Bdg 107
Bdg 118



Wet surface treatments: cleaning, etching

- cleaning service of all Ultra High Vacuum components** in detergents (chambers up to 7 m length) and solvents (Dualene 1601S modified alcohol)
- as preparation for other processes: PVD coating, welding, brazing
- chemical **etching** (acids, bases) **and passivation**, before plating, PVD coating, welding or for thin film removal

NB: **no** clean room environment



Alkaline
detergent
bath

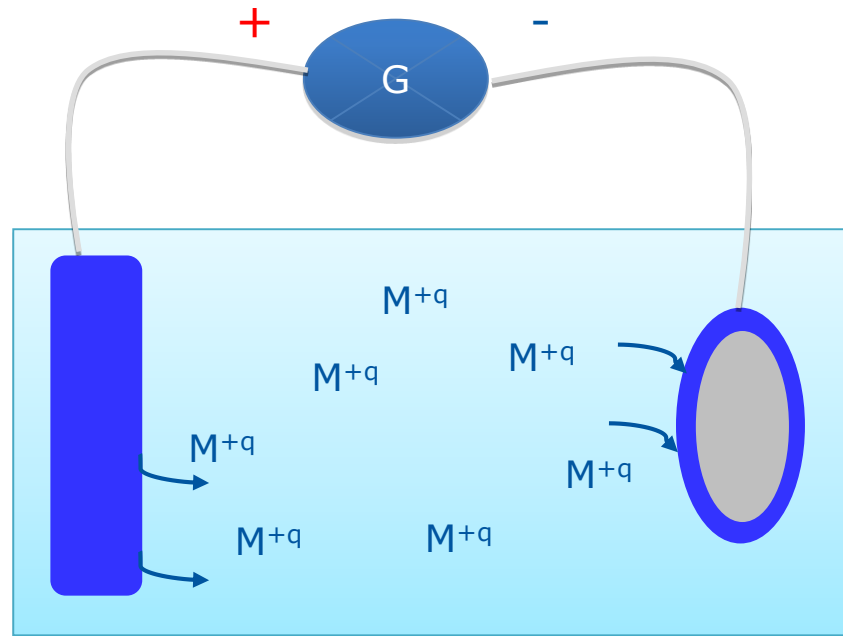
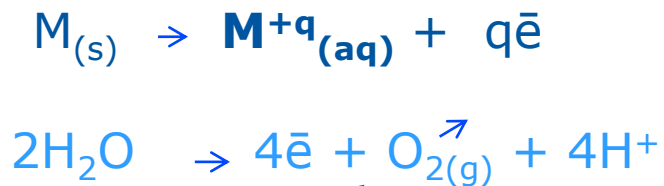


Solvent based
cleaning machine

Plating and electropolishing schemes

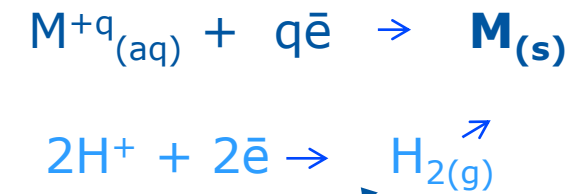
Can do **electropolishing** (dissolution) on this side

Anodes :



Can do **plating** and electroforming on this side

Cathodes:

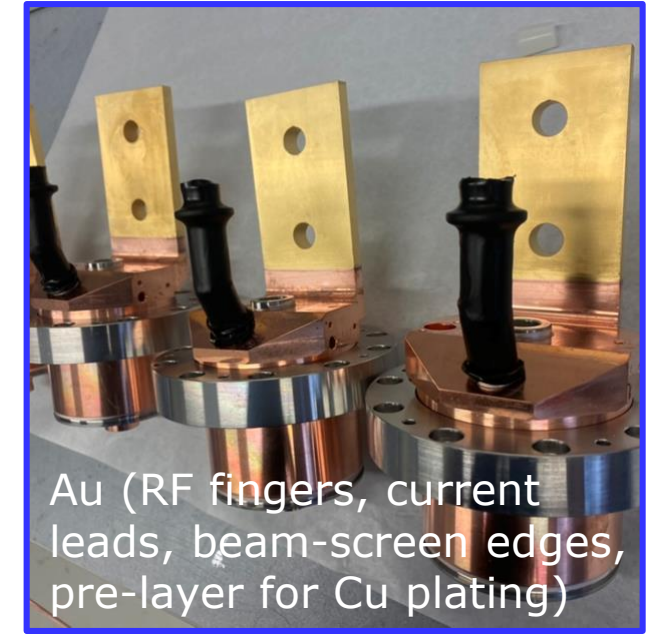
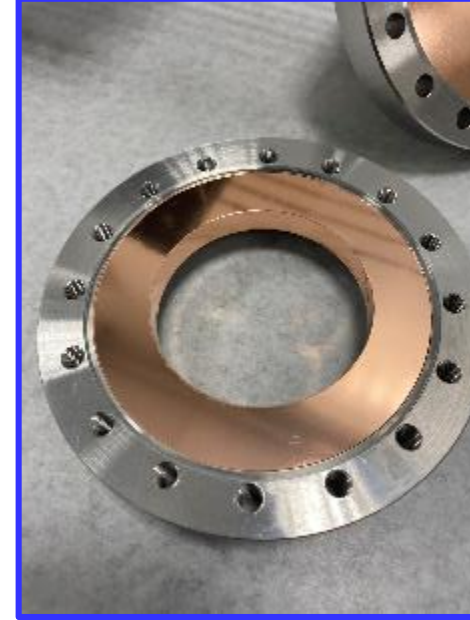
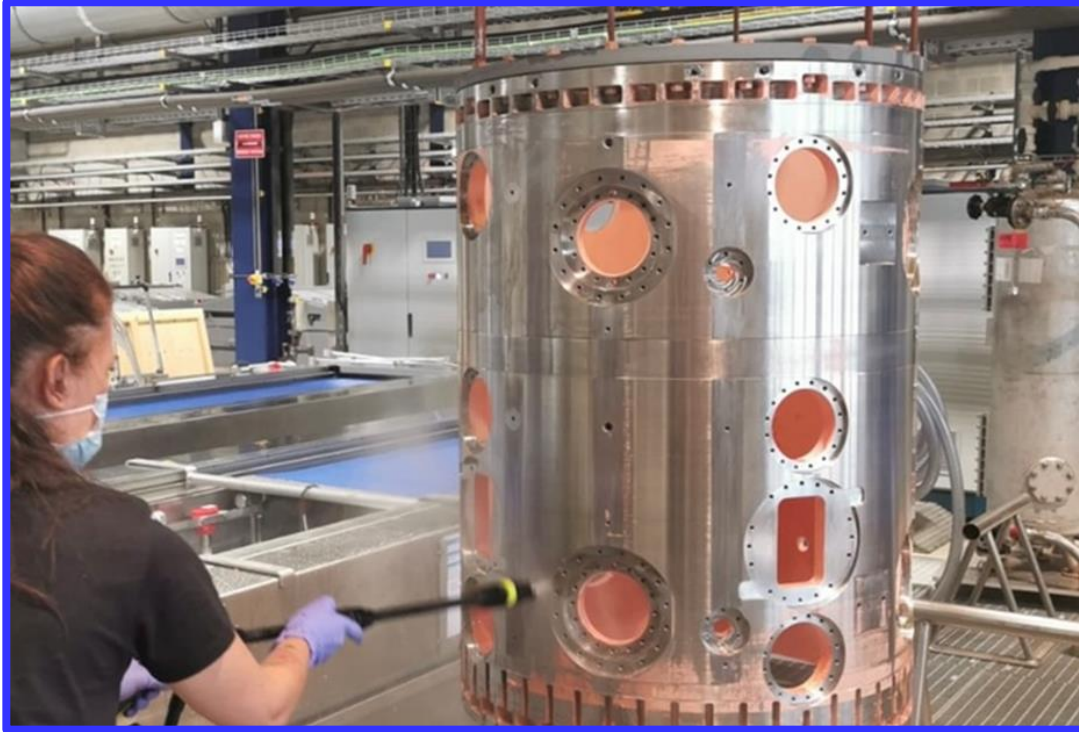


NB: the bath, the concentrations, the current density, the voltages, the temperature, the bath agitation are specific for each processes and material



Metal plating

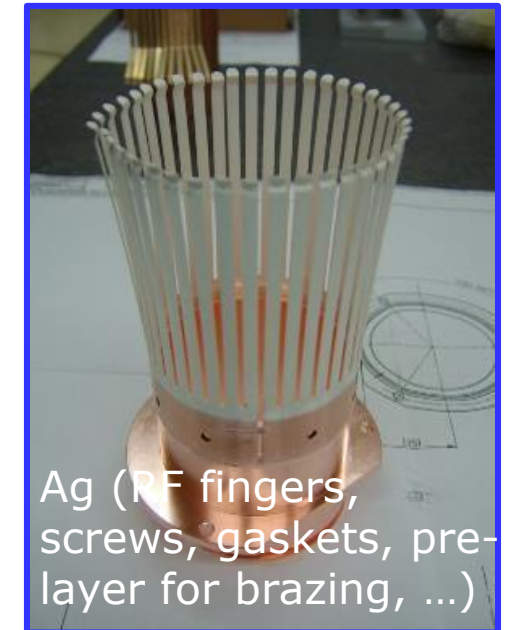
- on substrates like **StSt**, **Cu**, **Al** and their alloys
- by layers of **Ni** (pre-layer for Cu/StSt plating and StSt vacuum brazing...), **Cu**, **Au**, **Rh**, **Ag**
- typical thickness of 5-50 μm depending on the material and goals
- copper plating of large objects in dedicated (built on purpose) vessels



Au (RF fingers, current leads, beam-screen edges, pre-layer for Cu plating)



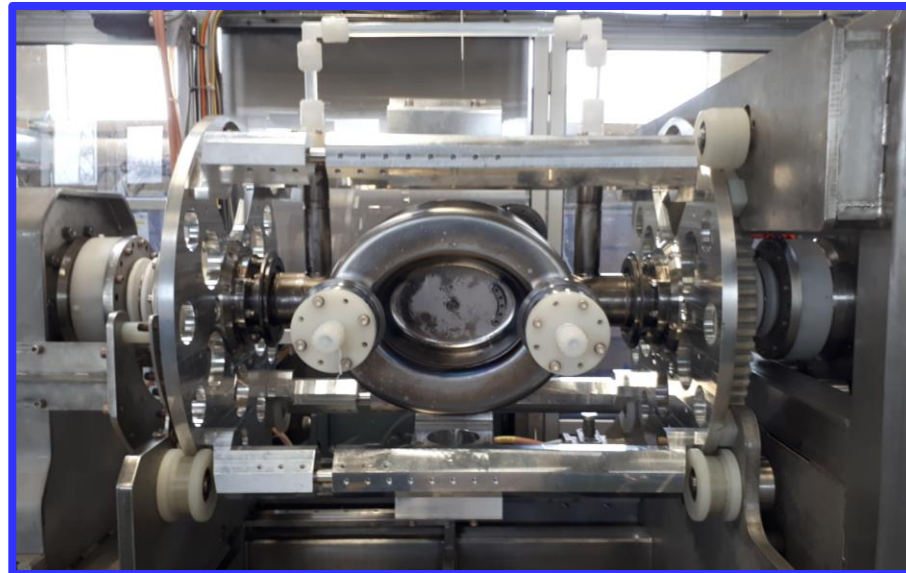
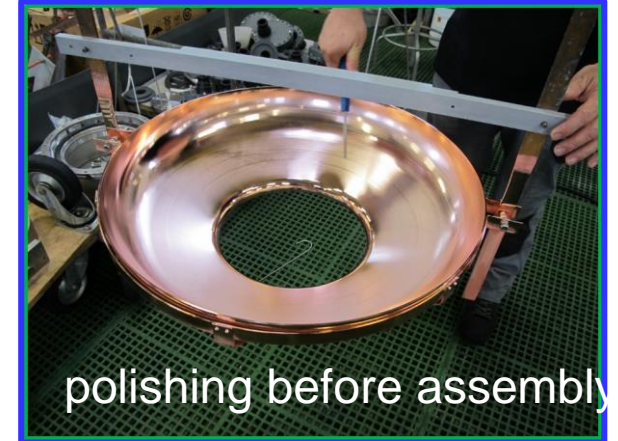
Rh (hard contact to RF fingers ...)



Ag (RF fingers, screws, gaskets, pre-layer for brazing, ...)

Chemical polishing and electropolishing

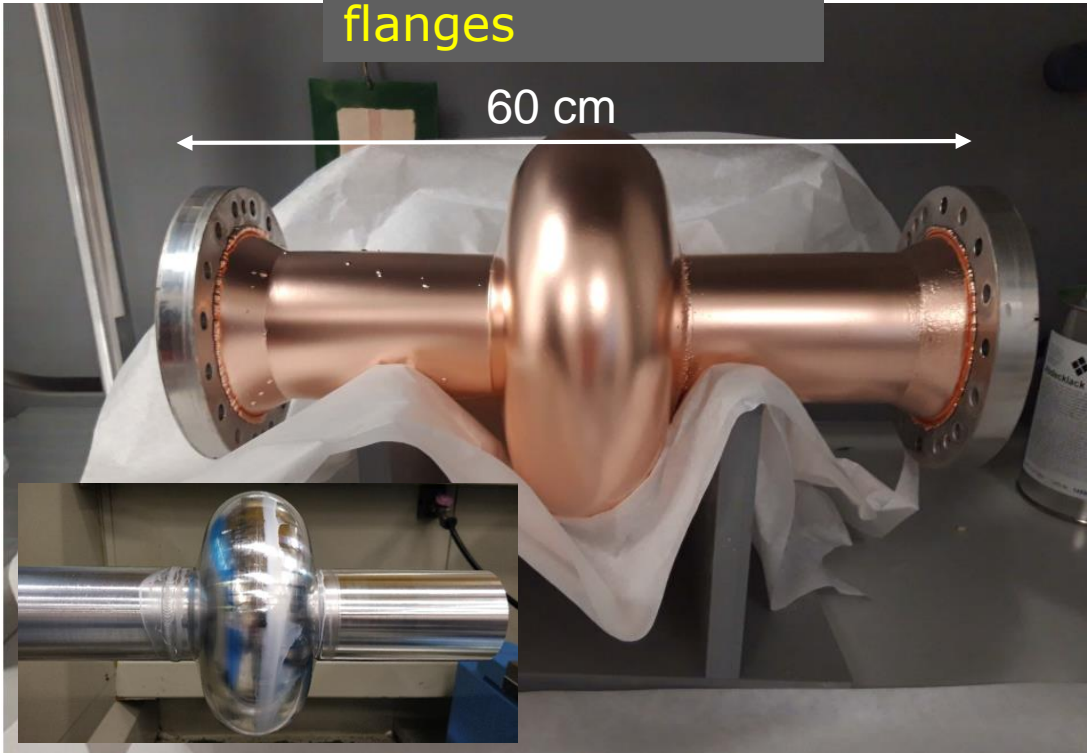
- chemical and electropolishing of copper (for superconducting RF cavity substrates before Nb coating)
- chemical polishing of Nb (CRAB cavities)
- electropolishing/polishing machine for cavities
- StSt electropolishing
- if necessary simulations for R&D can be done by COMSOL



Electroforming: combining machining, plating and etching

Cu electroforming: starting from an internal aluminium mandrel + thin copper coating by magnetron sputtering + electroplating of thick copper + mandrel removal by chemical etching

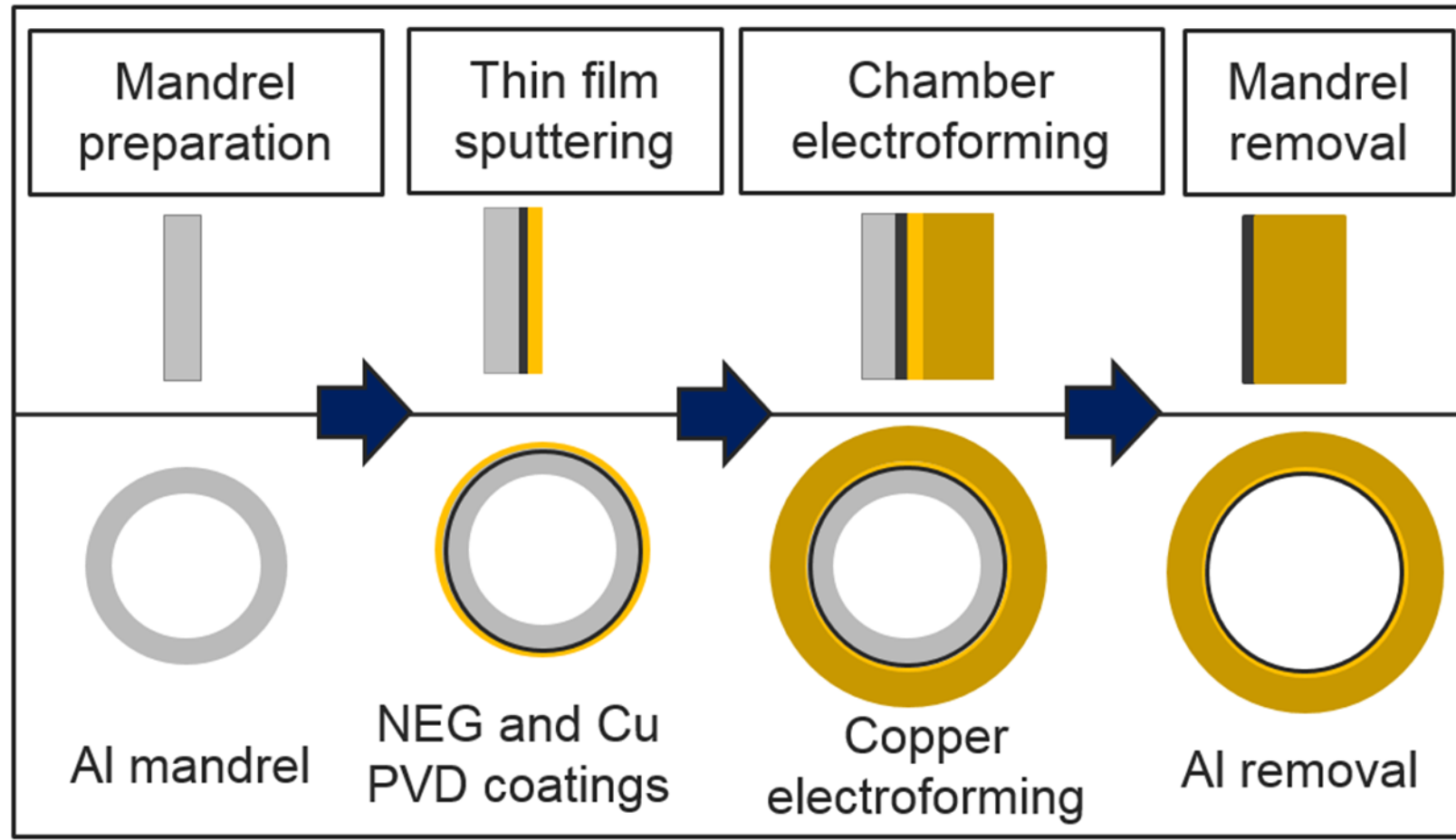
1.3GHz RF cavity
with integrated
flanges



Vacuum chamber (ondulator)
6mm diam, 0.2 mm wall thickness,
integrated flanges and stiffener



Combination of different technologies: electroforming, etching, PVD



Wet surface treatments: copper plating on 3D printed polymers

- in collaboration with EN-MME, TE-MSD polymer lab, EP-DT
- Mock-ups for low power RF testing and design validation
- 3D printing in Accura polymer + 30 um copper plating on a pre-layer of chemical carbon based conductor
- complex configuration of electrodes to get a good thickness distribution



Thank you!

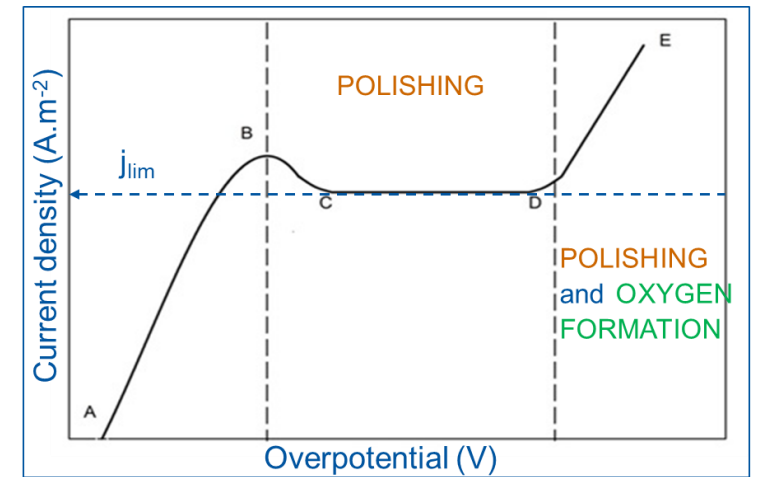
Questions?

Reference persons: Leonel Ferreira, Marc Thiebert

Dedicated sharepoint to submit jobs (after getting access rights) :
<https://espace.cern.ch/TE-VSC-job-requests/Lists/Surface%20Treatment%202023/AllItems.aspx>

Electropolishing

Electropolishing (EP) is an anodic dissolution process that reduces the roughness of a metal surface.



Example of an anodic polarisation curve

