

Cu/Nb QPR Surface Preparation Protocol in the Framework of ARIES Project



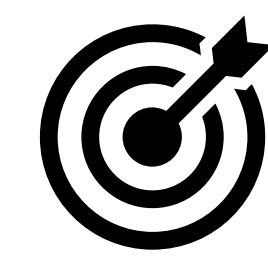
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Introduction

The Quadrupole Resonator is a powerful tool for SRF R&D on thin films. It allows to perform Q vs E measurements on flat sample rather than a curved surface of a cavity. For the investigation of SC coatings on copper substrates, e-beam welded Cu/Nb samples have been prepared for the QPR. However, the presence of two metals, in particular at the interface makes proper polishing of both surfaces challenging due the different chemical behavior of both components. In this work we present the protocol developed for surface preparation of the coexisting Cu and Nb phases and the results obtained for 5 different samples. The work was performed in the framework of the ARIES project.

Working protocol

1. Lathe machining
Low speed, 40 μm
2. Ultrasound cleaning
(GP1740, distilled water)
❖ 20% Chloridric acid
Indium removal
3. Ammonium persulfate etching
4. Electropolishing (10-30 min), 10-20 μm
5. Water rinsing, Ultrasound cleaning
6. Passivation (10 g/l Sulfamic acid)
7. High pressure rinsing (150 atm)
8. Water rinsing, ethanol rinsing, N₂ drying.
9. Vacuum chamber transfer.
10. Clean room mounting of the QPR sample inside the vacuum chamber
11. Vacuuming and Argon fluxing up to 1,1 atm.
12. Packaging to the partner institution.



AIM of the work

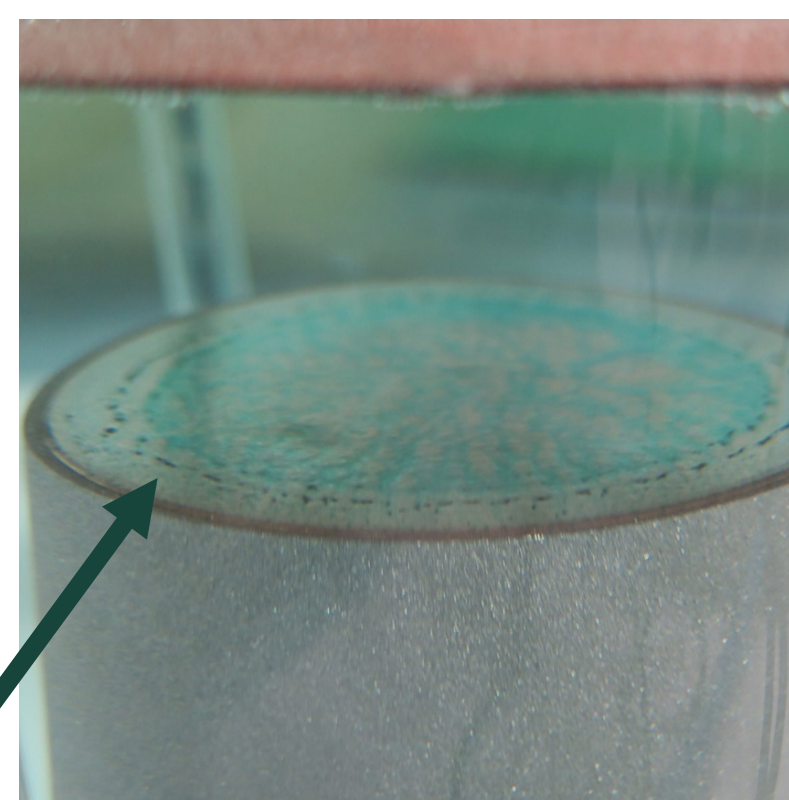
The present work is a summary of the final preparation protocol of the QPR samples, that was established during ARIES project lifetime. The protocol was used to prepare the Cu surfaces of the Nb/Cu joint QPR sample.



Optimization of the protocol

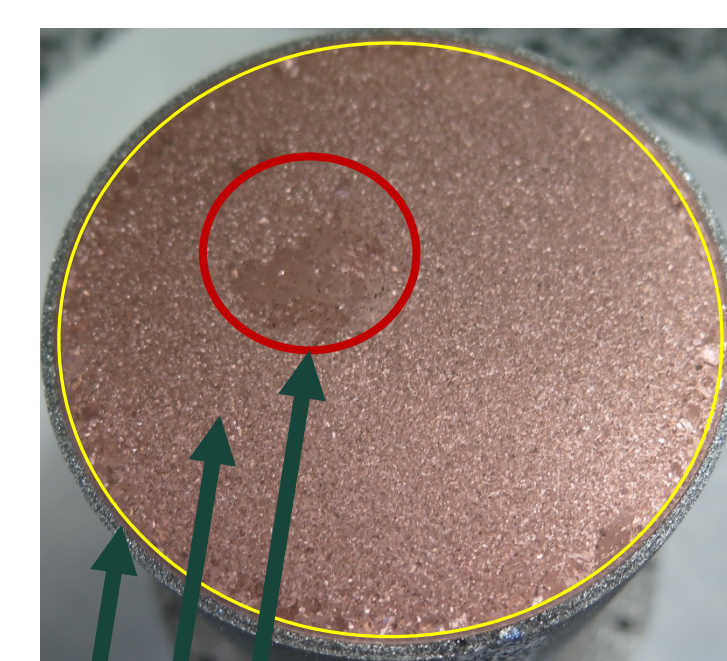
Mechanical polishing

Initial roughness ($R_a \sim 1.6 \mu\text{m}$, $R_z \sim 12 \mu\text{m}$) of the QPR samples forced us to do lathe polishing. 270 RPM and minimum 40 μm layer removed in one pass. Higher RPM could lead to the non-uniform viscous layer formation during EP.



Stripping

In the workflow of the project there were available 5 QPR Nb/Cu samples. To redeposit the Cu substrate surface, stripping solution were applied. Treatment is limited in time (<30 min). To ensure that SC film was removed, persulfate etching is applied, that highlight copper grains and can indicate possible local overheating.



Highest grain size.
Middle grain size.
Lowest grain size.

Electropolishing

Standard EP procedure was used of 3:2 volume ratio H₃PO₄:n-Butanol solution. Low polishing time, with voltage load of 2-3 V to decrease production of the O₂. Working temperature was kept at 40 °C. A positive side effect was noticed: working current densities are doubled from 0,03 to 0,06 A/cm².

Conclusions

Present work summarise 2-year activity and resulting preparation protocol of the QPR workpieces. Standard procedures of SC cavities of INFN-LNL were adapted and optimized for the QPR sample shape.