Update in deposition of Nb Thick Films on Cu for 6GHz cavities

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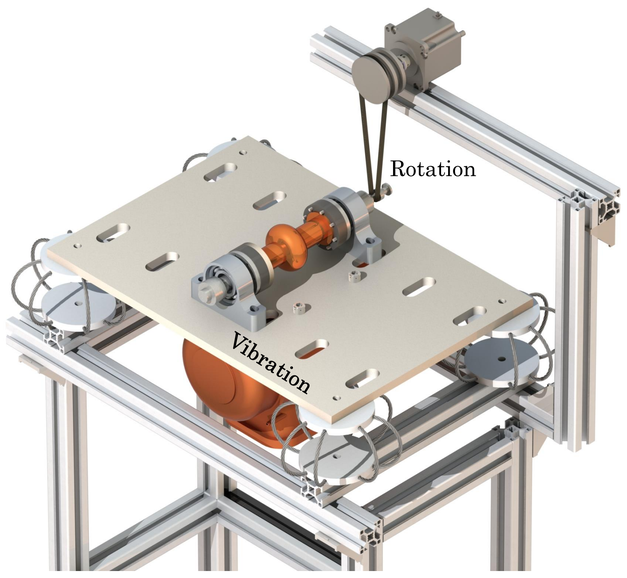
Abstract

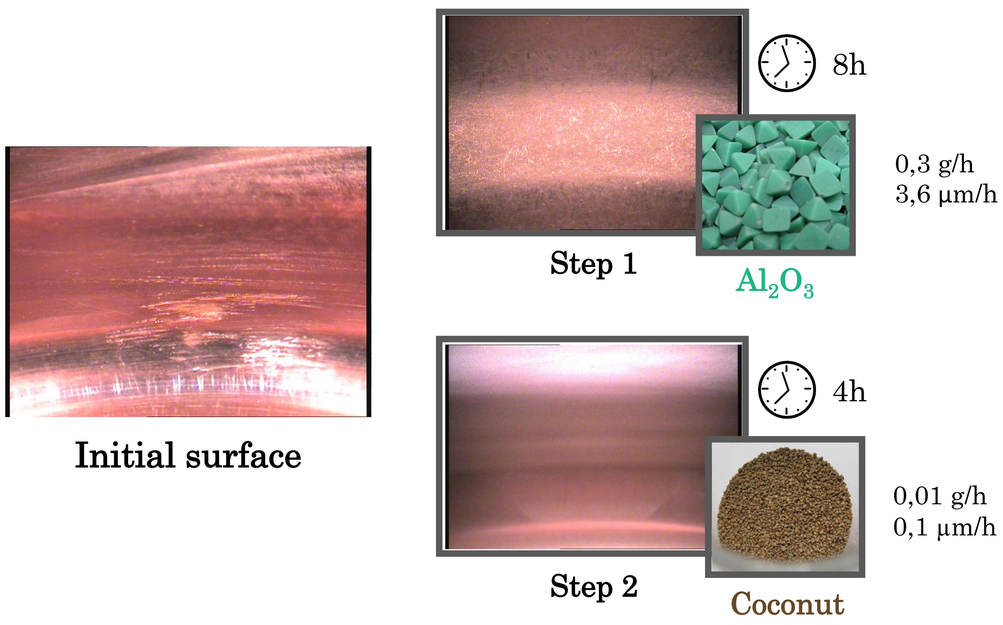
Two main approaches are taken into consideration for this research: substrate and film reproducibility. In order to improve the substrate reproducibility, the standard mechanical grinding of the 6GHz cavities that leads to defects on the inner surface of the cavities that can remain even after chemical treatments, has been replaced for Vibrotumbling. For the film reproducibility, a Nb thick film between 40 and 70 microns is deposited to reproduce bulk Nb superconducting properties. On the other hand, we report the installed experimental setup to study the influence of trapped flux in 6 GHz cavities in: Nb bulk, Nb on Cu thin film and Nb on copper thick film.

Vibro-Tumbling

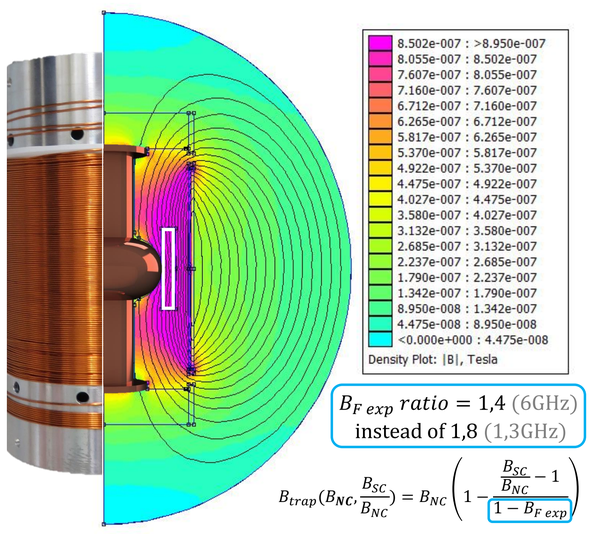
Nowadays, the mechanical treatment applied, was the mechanical grinding. After the grinding, the surface appears polished, but some deep scratches remain and it is not possible to remove them even with the EP. To solve this problem a vibro-tumbling system has been designed, built and successfully tested.



The vibro-tumbling process was optimized to a two-step procedure. The first The abrasive used in this step is alumina (Al_2O_3) and Rodastel 30 as wet media for 8 hours. The second steps is done in order to polish the surface with coconut powder for 4 hours is applied.

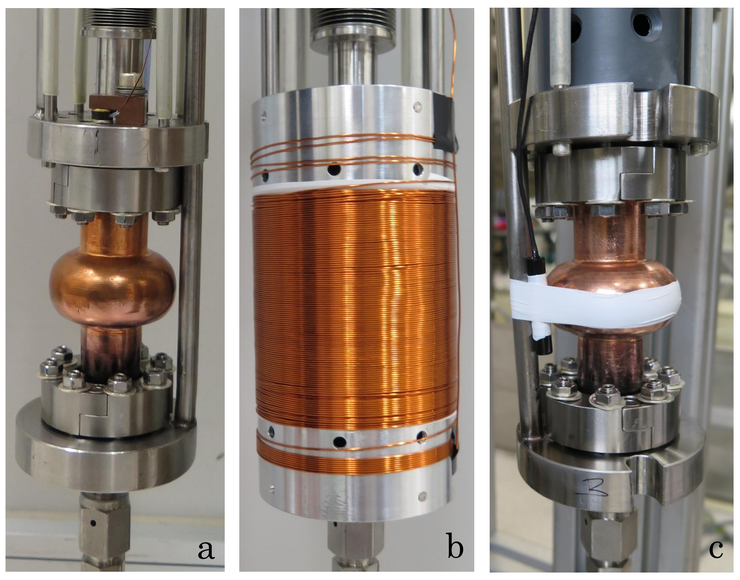


Magnetic trapped flux



In order to study the effect of the magnetic trapped flux in 6 GHz cavities, a new setup has been installed, to measure (Fluxgate Bartington® MAG-01H) and to induce magnetic field in the cavity during the Niobium transition to the superconducting state (at T_c). Simulations show magnetic flux expelled by the cavity in the superconducting state. Simulations show magnetic field ratio at full expulsion close 1,4 due to the fluxgate dimensions respect to the 6GHz cavity.

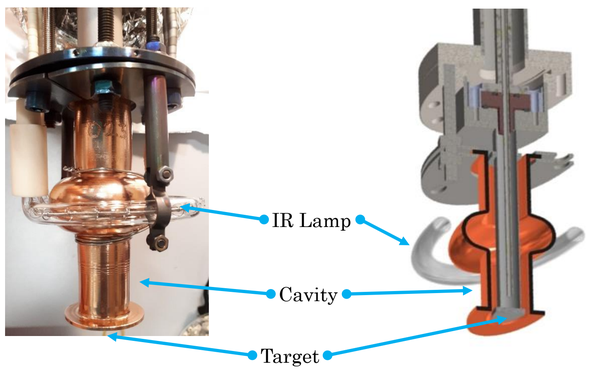
Measurements will be carried out at an annulled magnetic field and different induced magnetic fields in order to observe the degradation of Q on Nb and Cu cavities.

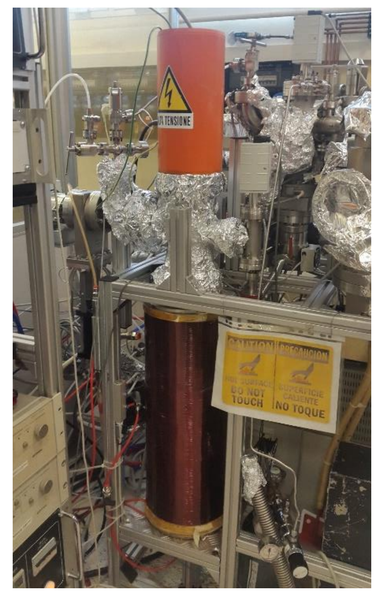


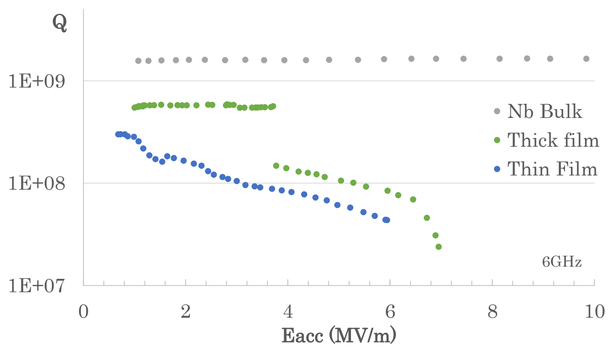
RF stand for 6GHz cavities.
(a) Complete.
(b) With coil.
(c) Inside coil with fluxgate.

Deposition of Nb on Cu 6GHz Cavities

For the deposition of Niobium on Copper 6 GHz cavities, the treated cavities are mounted in the deposition stand for sputtering process at 550°C.



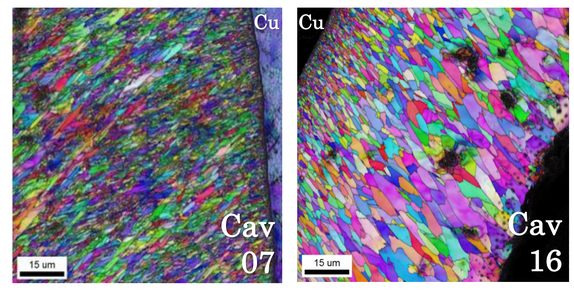


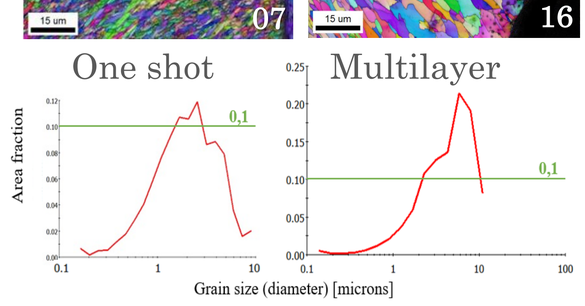


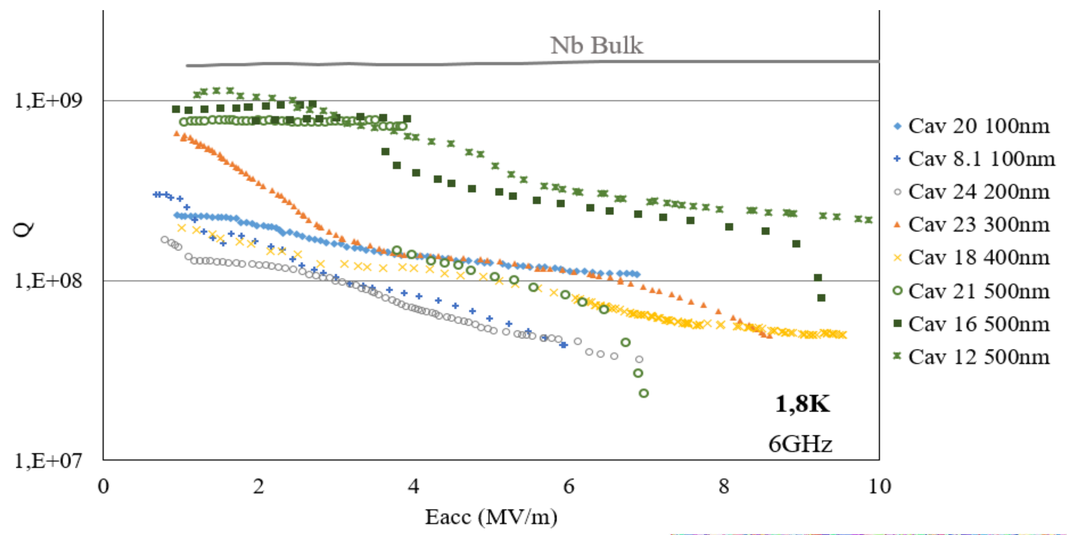
Nb thick film of around 70 microns, have demonstrated to present flat quality factor (Q) for low accelerating field (Eacc).

The cavities were deposited in one shot and in multilayer deposition mode. Morphology characterization with EBSD technique has been done and shows how multilayer deposition mode promotes a uniform and bigger grain growth respect to one shot mode.

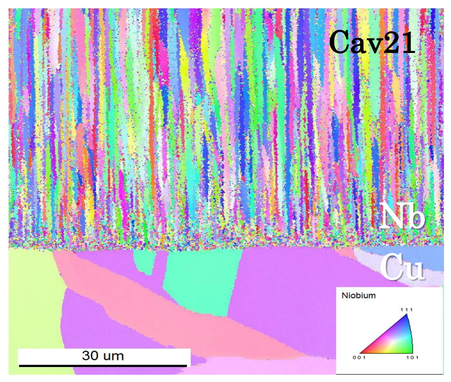
Cavities with different single layer deposition thickness were RF characterized.







Cavity 21 was cut and characterized by EBSD, it was possible to observe a columnar growth that presented a homogeneous grain size at approximately 40 microns from the copper substrate.



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