Vibro-tumbling as an Alternative to Standard Mechanical Polishing Techniques for SRF Cavities

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Abstract

Centrifugal Barrel Polishing is a common tool in the Nb bulk SC cavities treatment, prior to electropolishing. Indeed, the mechanical polishing is fundamental also in the superconducting thin film resonant cavities in which one of the main issues that limits the performances is the surface preparation. A promising vibro-tumbling technique is being studied and implemented with a possibility to replace or improve mechanical treatment steps (grinding, barrel polishing). The simplicity of the technology allows it to adapt to any cavity geometry, both for Nb and Cu materials. The presented work contains last results on 6 GHz cavities obtained at INFN LNL, both Nb bulk and Cu cavities. Thick films of Nb will be deposited on Cu substrates to test the influence of vibro-tumbling on RF cavity performances.

Introduction

Small dimensions of 6 GHz cavities challenge us to improve internal treatment. Due to geometrical limitations, conventional mechanical treatment are not efficient (CBP) or even are not possible to use (lathe and milling). Compromise option is being used – grinding, that produce deep scratches. Thus, it is required to find more reliable and less destructive mechanical treatment to substitute grinding or at least improve after.

Studying the effect of vibro-tumbling treatment is not only important for 6 GHz cavity preparation, but also it could be useful for bigger sizes of the cavities (1,3 & 1,5 GHz). Vibro-tumbling is relatively easy to scale, since vibro-finishing is widely used in industries and there isn't any limitation.

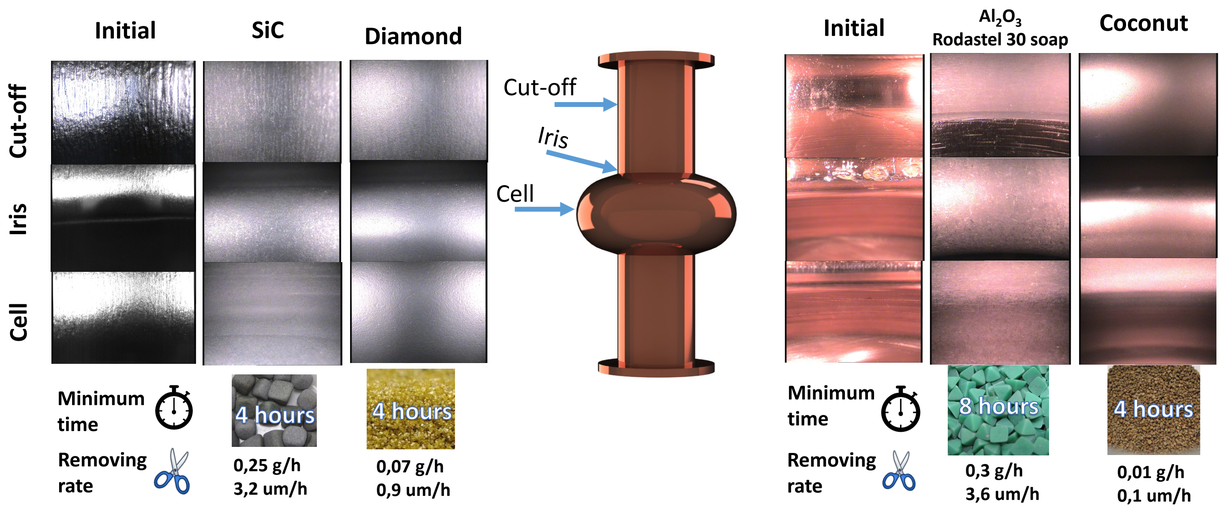
At this moment, it is required optimization of abrasive material usage to improve finishing steps and achieve hard cutting step.

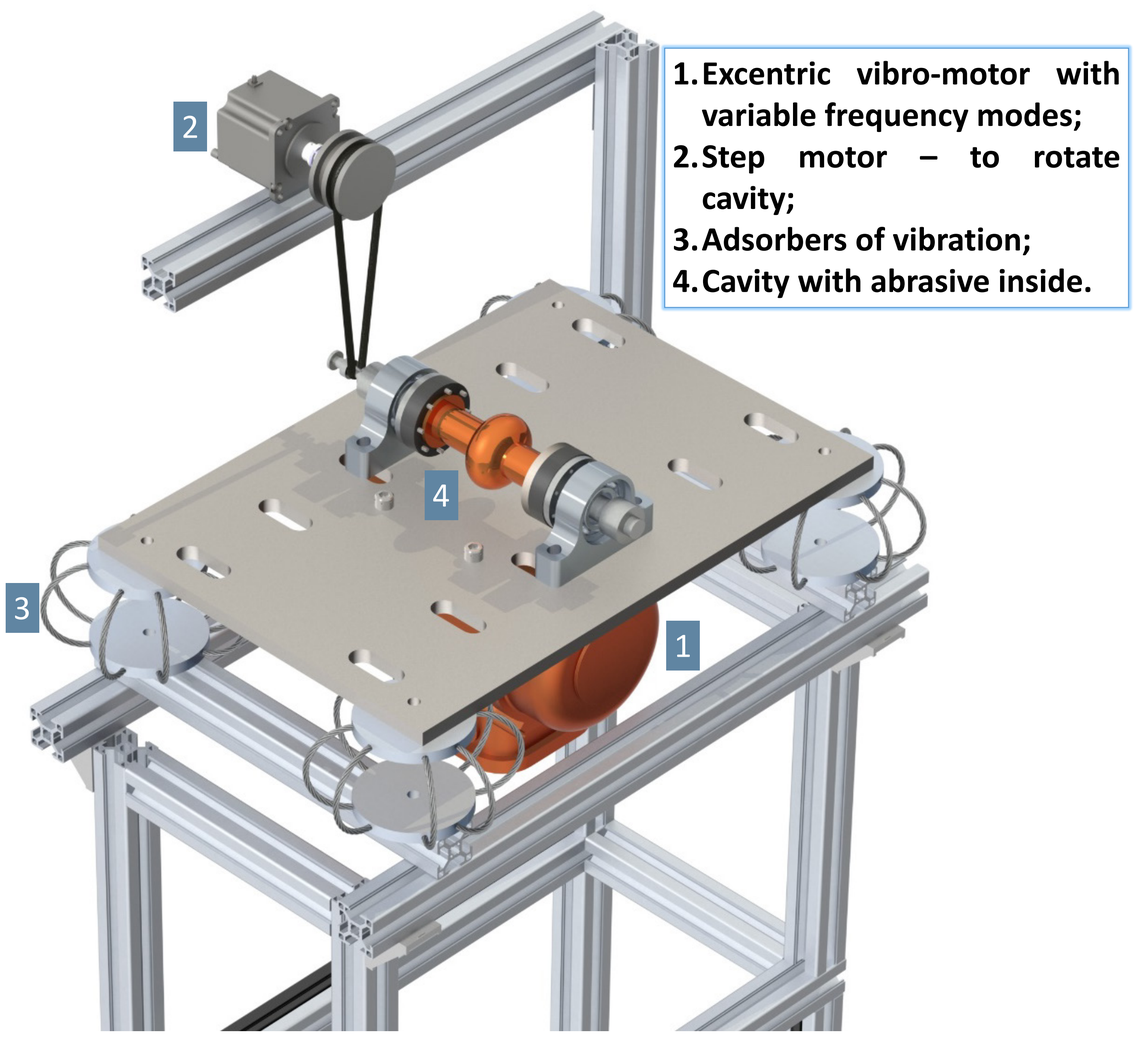
Methods and materials

At this moment, the technique is already in use for every cavity produced, treated and studied at INFN-LNL. Moreover, we have successfully adapted vibro-tumbling technique for treatment of both Nb and Cu 6 GHz cavities.

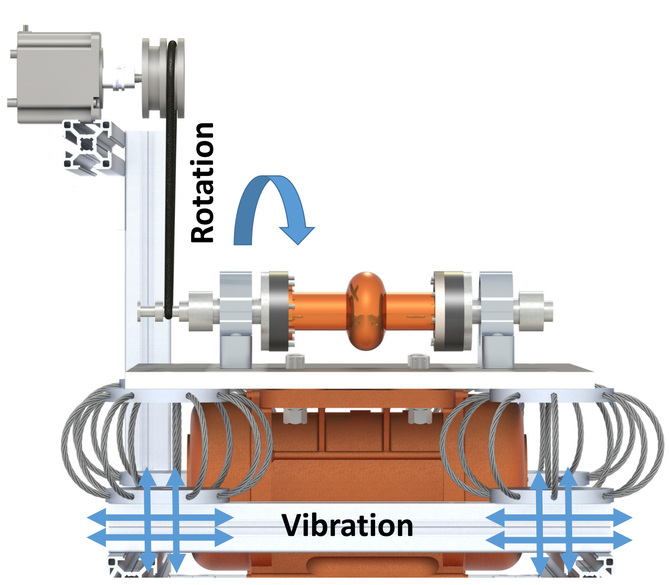
Roughness measurements were done with linear profilometer, photo of surface morphology with SEM, surface photo – dentist camera.

Recipes



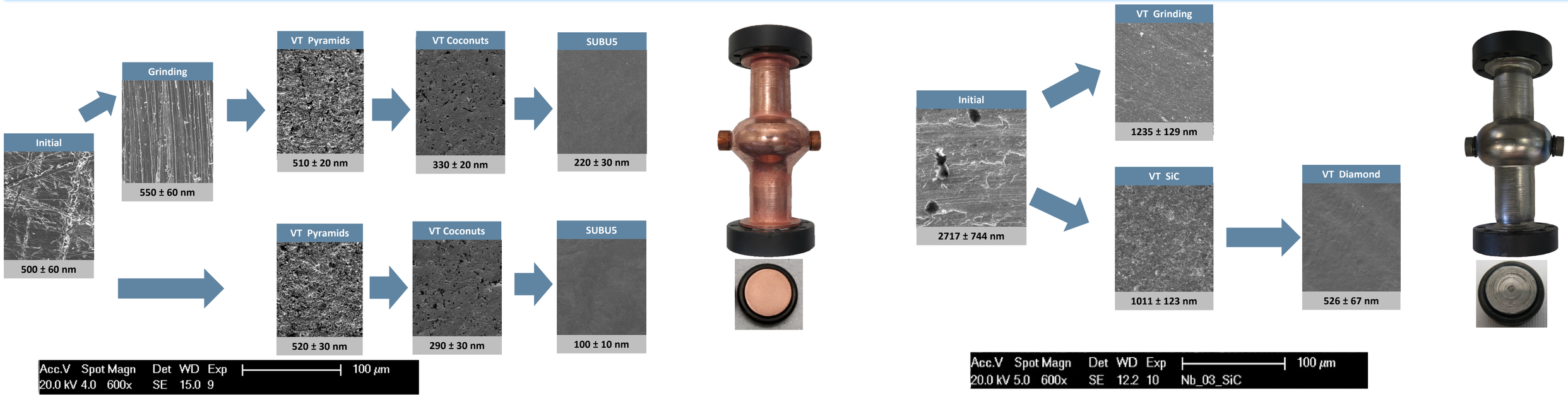


System built at INFN-LNL to treat both Nb and Cu 6 Ghz cavities



Schematic view of forces, that are affecting the cavity

Schematic view of Cu 6 GHz cavity abrasive load before vibro-treatment



SEM photos and roughness measurements obtained on planar Cu and Nb samples

Acknowledgments

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Results and conclusions

Vibro-tumbling system were adopted and applied as a standard treatment in the 6 GHz cavity treatment protocol at LNL-INFN.

It was shown effects on morphology and roughness due to vibratory finishing. Further investigations are required.

The future goal is set to adapt super-hard abrasives and to improve cutting and removing rate of material. Sputtering and measurements are planned, in order to correlate the effect of the surface preparation with the RF performances.