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Development and optimization of mechanical polishing process for superconducting accelerating cavities

Accelerator performance, in particular the cavity quality factor and the accelerating gradient field, depends on the physical and chemical characteristics of the superconducting radio-frequency (SRF) cavity surface. The preparation of the cavity walls has been one of the major challenges in SRF accelerator technology. Even a single microscopic defect, in such large macroscopic structures, could be a cause of local breakdown (quench) and could severely decrease the performance of cavity. In order to avoid this negative impact on performance, more than 150µm of the material is typically removed to recover a clean and damage-free surface.
Buffered chemical polishing (BCP) and electropolishing (EP) has been effectively used in manufacturing of cavities during many years. But both methods are very hazardous and very expensive for treatment which required a large of volumes acids.
Recent studies have successfully proved that a mechanical polishing (MP) could effectively cure a cavity. But MP gives us the problem of contamination of samples by different chemical elements. The optimization of the experimental conditions in the MP and their influence on the Nb etching rate and surface properties was performed on a flat Nb samples. This work shows that pollution could be reduced. Upon determining optimal experimental conditions on flat samples, the procedures will be applied to elliptical cavity, pursuing improvement of their RF performance.

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