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Mechanical Polishing of Nb3Sn Thin-Film Cavities

Sunday, 7 May 2023 16:00 (2 hours)

Nb3Sn superconducting radiofrequency (SRF) cavities have been an ongoing research topic for many years motivated by the potential for higher accelerating gradients and quality factors compared to niobium SRF cavities. The highest performing Nb3Sn cavities are manufactured using tin vapor-diffusion coating, which creates a Nb3Sn film with a surface roughness of around 100-200 nm. This is thought to be one of the limiting factors for the accelerating gradient of Nb3Sn cavities due to enhancement of magnetic field near sharp surface features. To smooth Nb3Sn SRF cavities, we have developed a mechanical polishing procedure which uses centrifugal barrel polishing to smooth the surface followed by a secondary tin coating step to repair the surface. We show that the accelerating field of a Nb3Sn SRF cavity is improved by applying this procedure. We also investigate the quench mechanism of the polished cavity by utilizing temperature mapping to measure which regions of the cavity experience heating during RF operation. We then cut samples from these regions and analyze the film microstructure and chemical composition in 3D using EDS and EBSD measurements together with a focused ion-beam (FIB) tomography technique.

Funding Agency

Footnotes

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Yes

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