Contribution ID: **52** Type: **Oral presention (by invitation only)**

Temperature Mapping System For Niobium Coated Copper Cavities

Tuesday 31 May 2022 14:36 (9 minutes)

Since the late 80's, CERN has pioneered development of thin film superconducting radio-frequency cavities for particle accelerators. This technology, used in LEP II, LHC and more recently in HIE-ISOLDE, presents many advantages. As a consequence, many efforts are put in place at CERN in view of its potential implementation in the FCC machines. However, niobium thin film cavities historically feature a strong increase in surface resistance with accelerating field, resulting in a progressive degradation of performance.
The goal of our work is to expand the range of potential applications of niobium coated copper cavities by pushing their present limits. Our current strategy attempts to optimize the copper substrate of 1.3 GHz cavities for the niobium film deposition in order to achieve performance competitive with that of the state-of-the-art bulk niobium cavities. In parallel to the characterization of niobium-copper cavities by standard measurements of the surface resistance and the penetration depth between 1.9 K and 9.3 K, a temperature mapping system is used to detect the mechanisms responsible of performance degradation. Unlike most of the temperature mapping systems currently in operation, this system is specially designed for copper coated cavities. Since the thermal diffusivity of copper is noticeably high at liquid helium temperatures, the detection of heat losses in copper coated cavities turns out to be extremely challenging in comparison to that in bulk niobium cavities. We will report how we overcome this limitation in order to cope with our requirements. Furthermore, temperature maps of niobium-copper cavities, tested at CERN, will be shown.

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Session Classification: Technology

Track Classification: SRF Programme