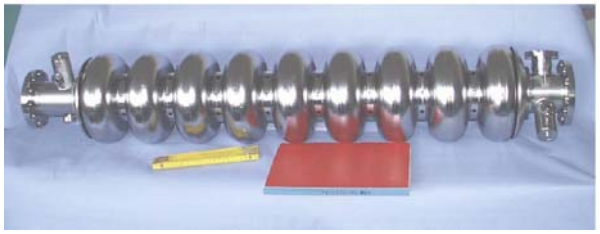
SRF



Deliverable 6.3.1.9: «DC field emission: Evaluation of scanning results »
Deliverable 6.3.2.6: « DC field emission: Evaluate strong emitter investigations »

Enhanced Field Emission from Metallic Surfaces and Nanowires
PhD Arti Dangwal, Wuppertal 2007, WUB-DIS 2007-08

Abstract

Detailed studies of enhanced field emission EFE have been carried out in collaboration between DESY and the University of Wuppertal. An existing vacuum apparatus was improved by a new control and measurement software. Also substantial modifications of the instrumentation were implemented. This apparatus allows to scan samples of 10 cm^2 cm surfaces with a local resolution in the µm regime. A local DC voltage of up to 200MV/m could be applied and currents starting from 1 nA were recorded. High resolution SEM and EDX measurements helped to identify individual emitters.
Detailed studies of EFE were done at surfaces which are typical for Niobium resonators in superconducting accelerator systems. This includes polycrystalline Niobium after chemical, electropolishing or dry ice cleaning treatment. In addition surfaces from large grain or even single crystal Nb material were scanned. Based on these measurements a statistically relevant conclusion about the nature and size of strong or week emitters could be drawn. Furthermore the benefit of typical surface cleaning methods could be investigated.
The PhD report of Arti Dangwal describes, discusses and summarizes the measured results. In addition a theoretical introduction to EFE and a very detailed and complete list of references is given.

Chapter 3 “DC field emission scanning measurements on electropolished Niobium samples” and chapter 4 “Effective removal of field emitting sites from metallic surfaces by dry ice cleaning” describe measurements relevant to deliverable 6.3.1.9 “scanning of surfaces after BCP, EP, High pressure rinsing (HPR) and Dry Ice Cleaning (DIC)”

Chapter 5 “Field emission from single crystal and large grain niobium cathodes” separates EFE effects from particles and grain boundaries and is relevant to deliverable 6.3.2.6 “Evaluate strong emitter investigations”. It is shown that there is no strong correlation between strong emission and size of the emitting particle. Nevertheless an upper limit of the particle size as function of the accelerating gradient can be predicted for EFE free operation of superconducting Niobium accelerating cavities.

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