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1	Enhancement of effective linear RF surface resistance of
2	superconducting surfaces by microscopic topography
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7	Abstract:
8	Minimization of Radio-Frequency (RF) dissipation on superconducting surfaces is of
9	interest for many applications. A prominent one is the use of Superconducting RF (SRF)
10	cavities for charged particle acceleration. In addition to our previous investigation which
11	characterized the occurrence of high-field non-linear losses by microscopic surface topography,
12	the topic of increased linear losses as a function of surface topographic character merits
13	consideration. Surfaces with isotropic homogeneous surface topography may be well
14	characterized by power spectral density (<i>PSD</i>) derived from systematic height measurements.
15	PSD characterizations of representative mobilum cavity surface treatments have been developed. Electro Deliching (ED) None Mechanical Deliching (NMD) and Contrifued Derrol
10	Deliching (CDD) A next what is a model based on DSD statistical enclosis is used to calculate

developed: Electro-Polishing (*EP*), Nano-Mechanical Polishing (*NMP*), and Centrifugal Barrel
 Polishing (*CBP*). A perturbation model based on PSD statistical analysis is used to calculate
 additional RF loss on these surfaces when superconducting. The model assesses the penetration
 depth effects for a superconductor. We thus estimate the RF power dissipation ratio between
 these rough surfaces and an ideal smooth surface.

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1. Introduction

It is known that surface roughness can play an important role in RF component performance. 22 [1] Relative to the Hammerstad model, studies submit (in unison) that there is excessive RF loss 23 24 found present in rough copper surface(s). [2] A rough surface increases the average surface 25 resistance in resonators, thus leading to quality factor degradation of SRF cavities. Furthermore, the penetration depth of the superconducting materials can be comparable to the fine-scale surface 26 roughness. [3] Therefore, such SRF surface roughness can alter the electromagnetic fields within 27 the penetration depth, which may increase the RF loss. The RF electromagnetic fields infiltrate the 28 29 surfaces and modify the distribution of the surface currents, which flow within the penetration 30 depth.

In the RF wave view, the reflection of the incident wave is transformed by the rough surfaces. The local magnetic fields will conformably align with the rough surface(s) and locally determine the RF loss.[3,4] In a resonator, RF waves form resonating modes at certain frequencies. At a local surface point, the incident wave is a summation of a set of plane waves from multiple Download English Version:

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