**Introduction:**
Electropolishing of niobium is currently an important part of attaining the best performance of SRF cavities. We endeavour to develop sufficient understanding of the process dynamics to gain predictive power over specific topographies subjected to controlled electropolishing conditions. This work examines the evolution of highly reproducible Nb surface morphology produced by centrifugal barrel polishing (CBP) of fine-grain and single-crystal material as this material is electropolished under different well-controlled conditions. The morphology evolution of Nb surface has been described using a combined approach of scaling analysis and predictions of the electropolishing theory. A preliminary computational model has been developed that simulates the evolution of specific topography of a niobium surface under parameterized conditions. This work is expected to lead to the direct linking of starting surface morphology specification, specific processing protocol, and conditions. This work is expected to lead to the direct linking of starting surface morphology specification, specific processing protocol, and conditions. This work is expected to lead to the direct linking of starting surface morphology specification, specific processing protocol, and conditions. This work is expected to lead to the direct linking of starting surface morphology specification, specific processing protocol, and conditions.

**Scaling Formalism and Mathematical Theory of Electropolishing**

The surface is treated as self-affine fractal geometry. The morphology evolution of niobium surface during the electropolishing could be described using a combined approach of scaling analysis and predictions of the electropolishing theory.

**Scaling Analysis**

For \( l \leq l_c \), \( w = w_0 \) (roughness exponent)

For \( l \geq l_c \), \( w = w_{\text{sat}} \) (const.)


**Electropolishing of niobium is currently an important part of attaining the best performance of SRF cavities. We endeavour to develop sufficient understanding of the process dynamics to gain predictive power over specific topographies subjected to controlled electropolishing conditions. This work examines the evolution of highly reproducible Nb surface morphology produced by centrifugal barrel polishing (CBP) of fine-grain and single-crystal material as this material is electropolished under different well-controlled conditions. The morphology evolution of Nb surface has been described using a combined approach of scaling analysis and predictions of the electropolishing theory. A preliminary computational model has been developed that simulates the evolution of specific topography of a niobium surface under parameterized conditions. This work is expected to lead to the direct linking of starting surface morphology specification, specific processing protocol, and consistently attained finished surface condition.

**Simulation Algorithm for Nb Electropolishing**

For ideal Nb electropolishing

\[
B = \frac{\ln(l_c/a)}{2l_c} \]

\( a_{\text{sat}} = 0.34 \times 10^{-9} m \)

From limited analysis of AFM measurements, we noticed that \( B \) is function of temperature \( B_1 \) for \( T_1 \), further studies will be reported later.

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