Grain Boundary Flux Penetration in Niobium Sheet Sampled Across the Cavity Production Route

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**Issue**

Cavity performance is very sensitive to Nb surface quality and preparation. Premature flux penetration is one mode of cavity degradation – here we focus on how the cavity preparation route impacts flux penetration properties. Does the existing process optimize grain rather than grain boundary properties?

**Experiment**

Magneto optical (MO) and magnetization measurements were used to study the global and local magnetization of Nb samples taken through a cavity “optimization process” on cavity-quality fine grained (regular) sheet and on weld regions (large grains) samples. All measurements were made at 7K.

**Summary**

1. FC flux penetration state is much more uniform than when field is applied from the ZFC state – the sample surface is clearly implicated for locally varying flux penetration in the superconducting state.

2. The “optimization” (etch, HT at 750°C, etch, bake) reduces magnetization hysteresis, much of which comes from the surface, but enhances non-uniform flux penetration.

3. Flux penetration along GBs is particularly clear in the large grain weld samples.

4. Comparison of ZFC and FC images of the fully processed (120°C bake) weld samples shows perturbations of the local field in both cases – some GBs preferentially admit flux in the ZFC state and distort the induced current flow patterns which appear after reducing H to zero on field cooling.

5. The chemical etching processes developed for cavities enhance surface properties of grains but can degrade some grain boundary properties.