Exploration of Parameters that Affect High Field Q-Slope

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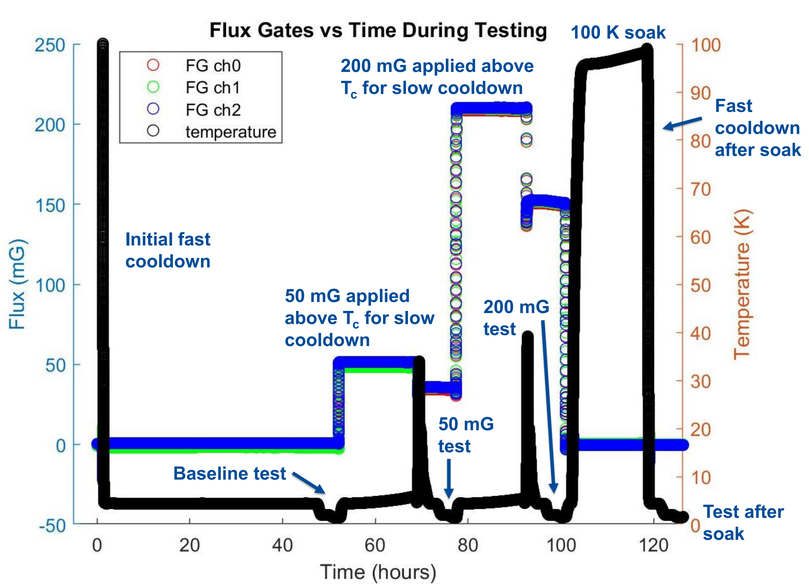
Motivation

- Onset of high field Q-slope (HFQS) around 25 MV/m prevents cavities in electropolished (EP) condition from reaching high quality factors at high gradients
- HFQS due to the precipitation of niobium hydrides during cooldown
- Hydrides are non-superconducting at 2 K and contribute to losses such as Q disease and HFQS

We follow a single-cell TESLA-shaped cavity that receives an 800 °C by 3-hour bake and EP treatment subjected to different RF testing conditions to observe potential effect on HFQS



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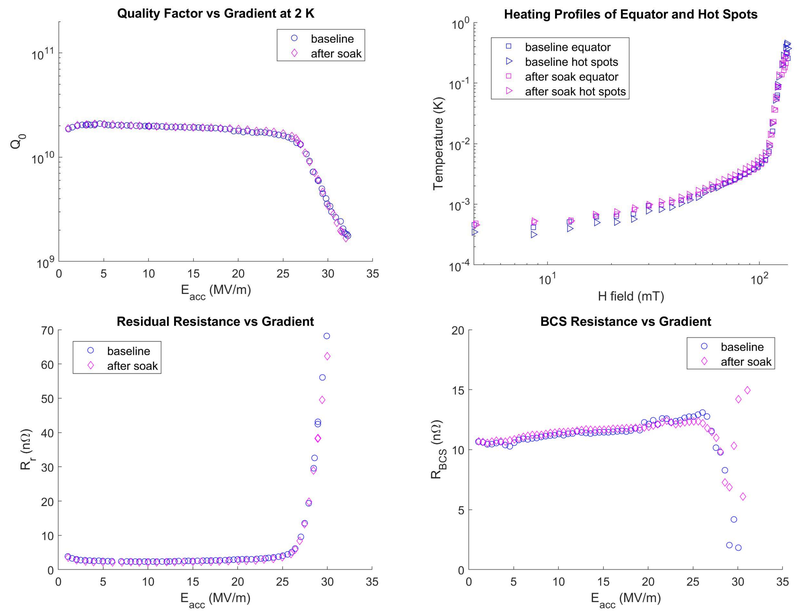
Effect of Size/Concentration of Hydrides

Experiment

- Cavity receives an 800 °C by 3-hour bake
- Tested after holding temperature at 100 K for 14 hours during cooldown to promote the growth of hydrides
- Correlate behavior of HFQS with increased hydride concentration



Identical performance before and after 100 K soak

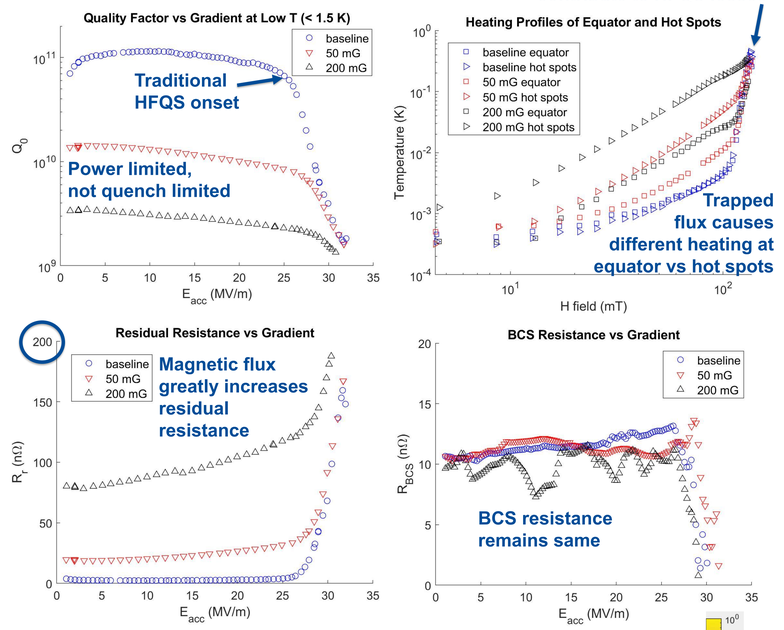
Results

- Verify 800 °C bake as robust for preventing additional hydride-based losses
- Shows cooldown procedures as irrelevant for hydride losses
- Safe to proceed with trapped magnetic flux testing without additional hydride interference

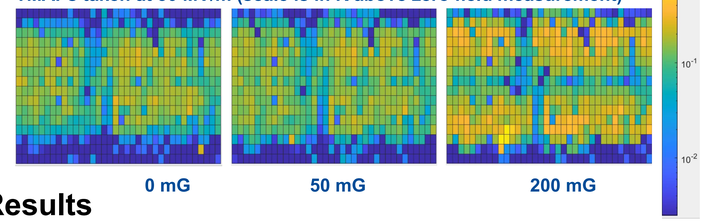
Effect of Trapped Magnetic Flux

Experiment

- Cavity tested after slow cooldown through T_c while applying different levels of ambient field (0 mG, 50 mG, and 200 mG)
- Observe HFQS and correlate behavior with amount of trapped flux



TMAPs taken at 30 MV/m (scale is in K above zero field measurement)



0 mG **50 mG** **200 mG**

Results

- Vortex oscillations affect heating before HFQS onset
- Observed levels of trapped flux do not affect HFQS