



Cornell Laboratory for
Accelerator-based Sciences and Education (CLASSE)



Tumble Polishing of SRF Cavities @ Cornell

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Physics



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- Outline

- What is tumble polishing? Why tumble polish?
- How does it work and compare to centrifugal barrel polishing?
- An example
- Summary and plans

- Collaborators:

- Hasan Padamsee
- Curtis Crawford



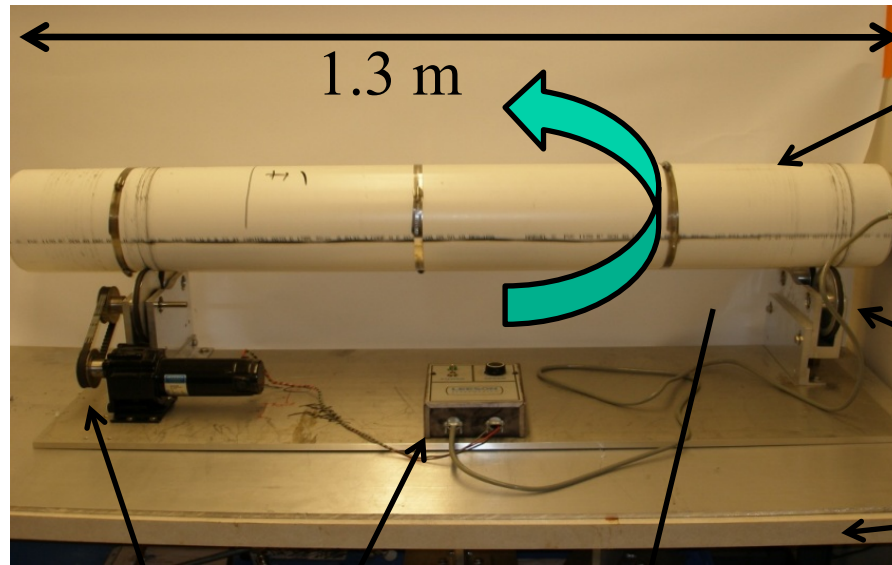
What is tumble polishing?

- Tumble polishing is an off-shoot of the KEK technique of centrifugal barrel polishing (T. Higuchi et al, “Centrifugal Barrel Polishing of L-Band Niobium Cavities,” 10th SRF Workshop, Pg. 431.)
- We:
 1. Fill the cavity with an abrasive Al_2O_3 ceramic media and DI H_2O mixture
 2. Roll the cavity about the beam axis
 3. Replace media every 24 hours
 4. Repeat until finished, 20mu/day for 28rpm, if tumbling media is replaced daily
- Tumble polishing allows for precise control over the surface area polished, e.g. polish only the equator weld $\pm 1^\circ$, polish only one cell, etc ...
- But tumble polishing does not remove material as fast as centrifugal barrel polishing, which rotates around two axes.



What is barrel polishing?

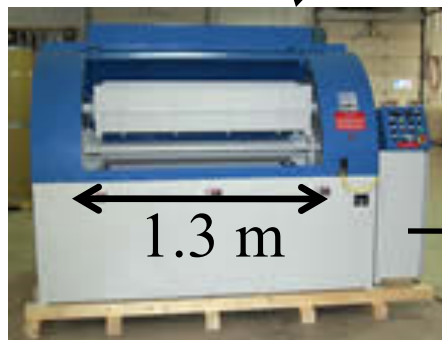
@ Cornell



Simple Gear Motor
Rotates a Wheel

Faster Material
Removal Rate

e.g. the mass
finishing model
HZ 280 is much
larger,
Will be at Cornell
this fall.





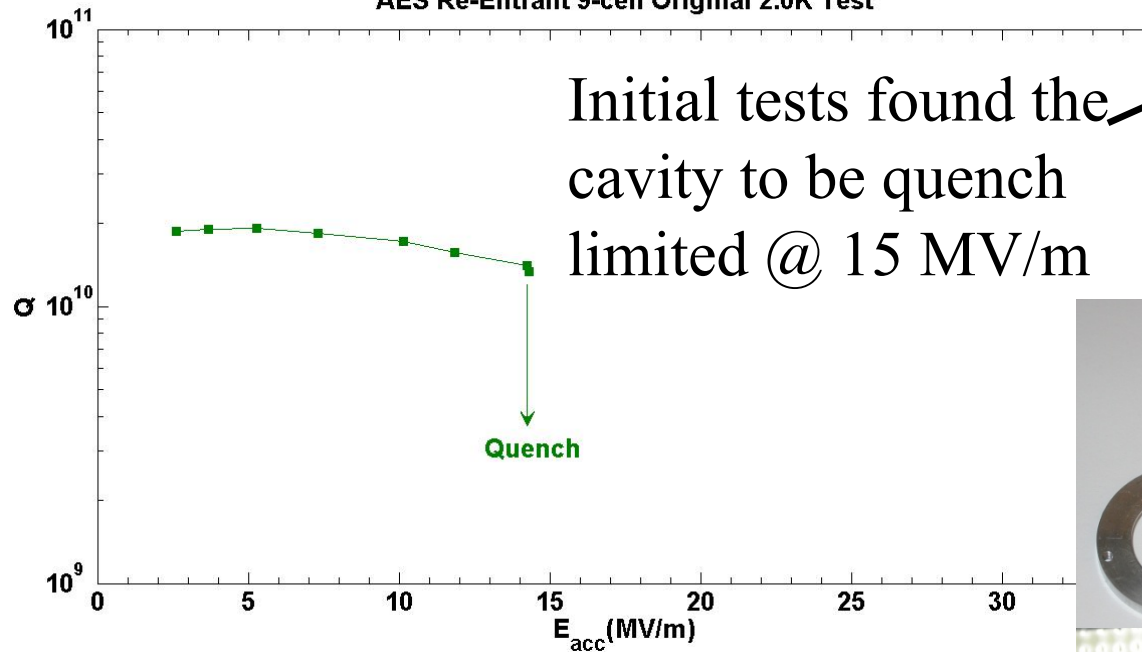
An example: the repair of LR9-1

- We employed tumble polishing to repair a pit defect which limited the performance of a nine-cell reentrant cavity fabricated by AES (in 2007).
- Originally this cavity quenched in the π -mode at $E_{\text{acc}} = 15 \text{ MV/m}$ at a weld pit in end cell number 1.
- After tumbling (to remove the defect), vertical electropolish (to smooth the surface) and H-degassing at JLAB this cavity now reaches 28 MV/m , Q_0 of 1.6×10^{10} , with quench in end cell number 9.
- This demonstrates that tumble polishing is an effective option to repair pit-defects
- The following slides review this work

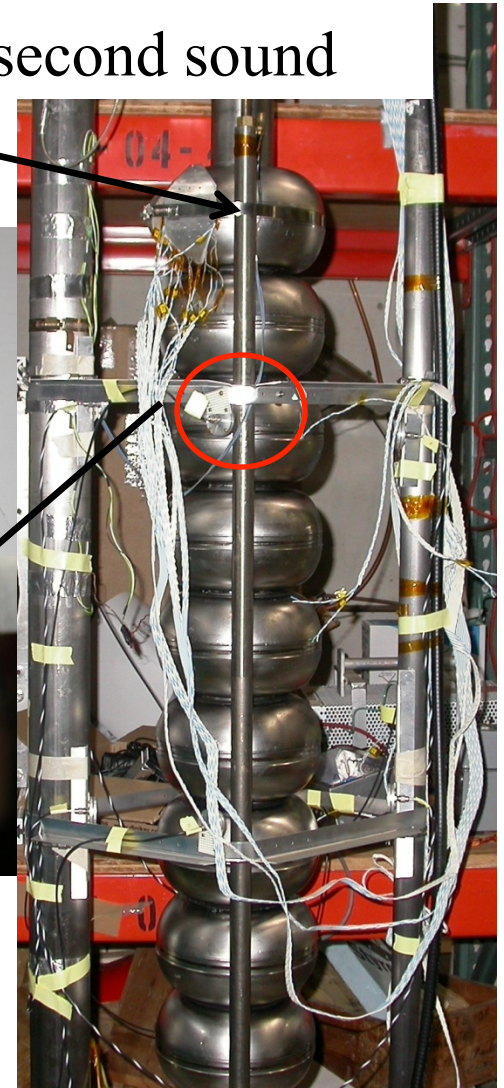
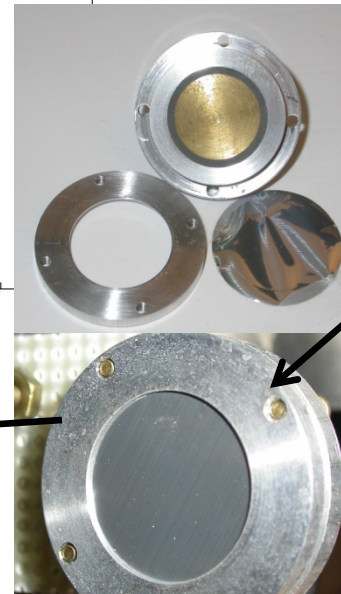
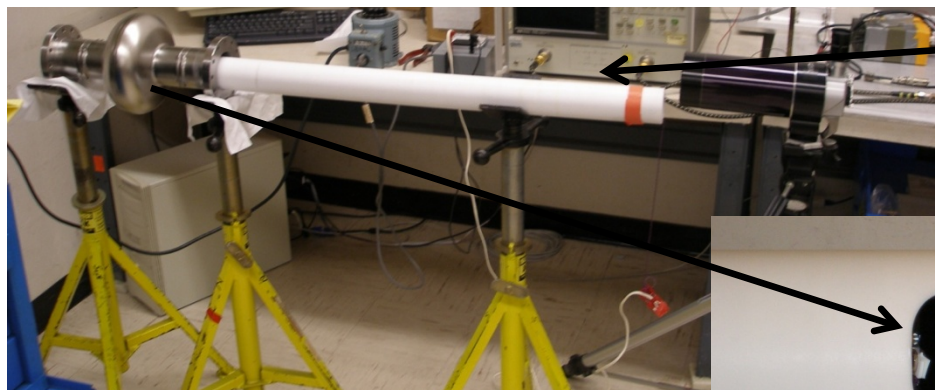


Initial LR9-1 Performance

AES Re-Entrant 9-cell Original 2.0K Test



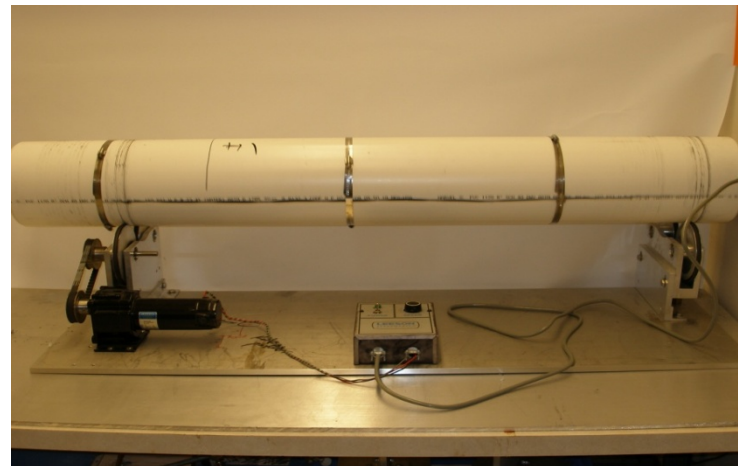
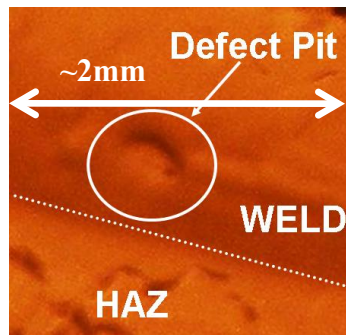
Located the defect with second sound



Visually characterized the defect



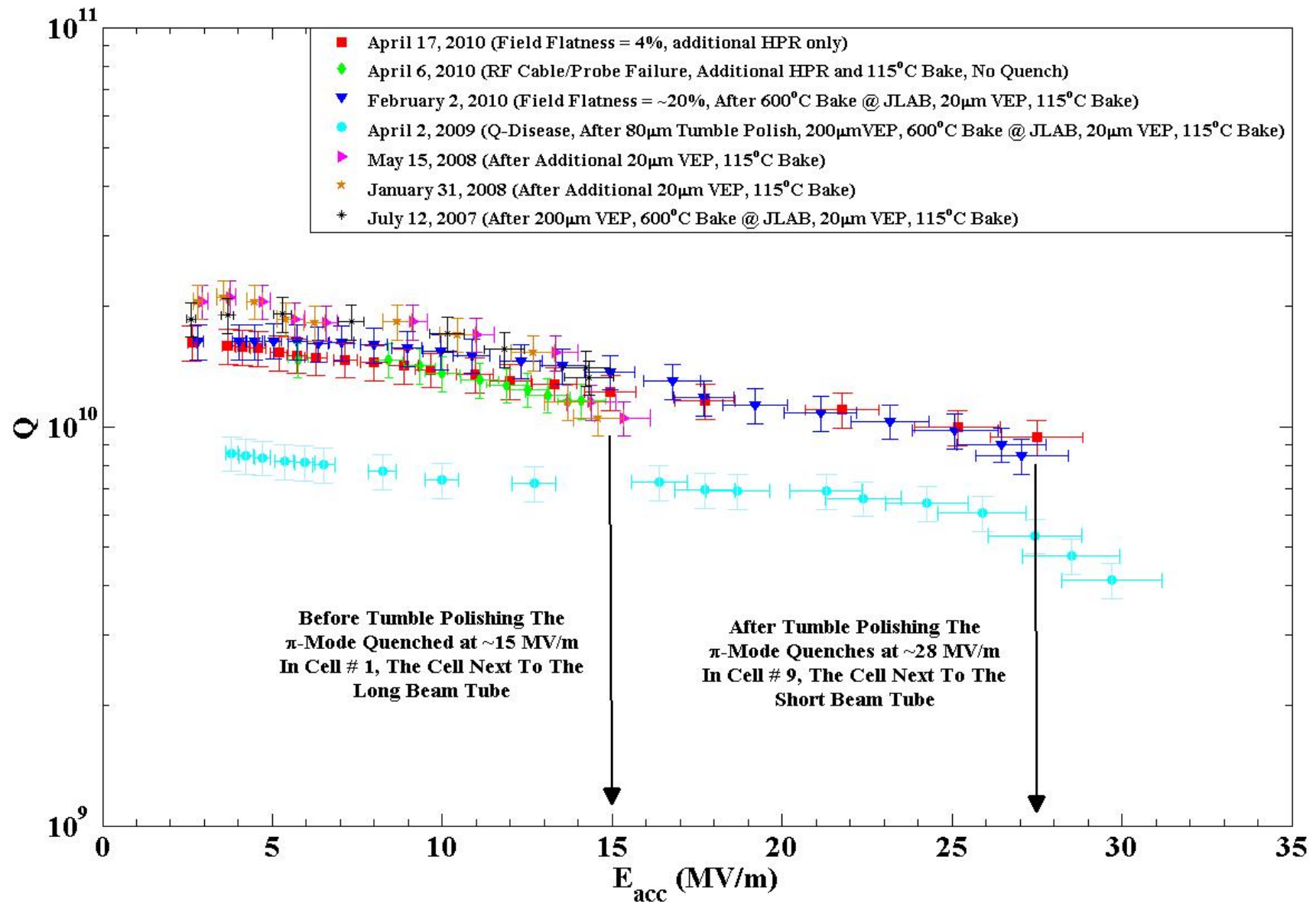
Observed Defect



Tumble Polished Until Gone

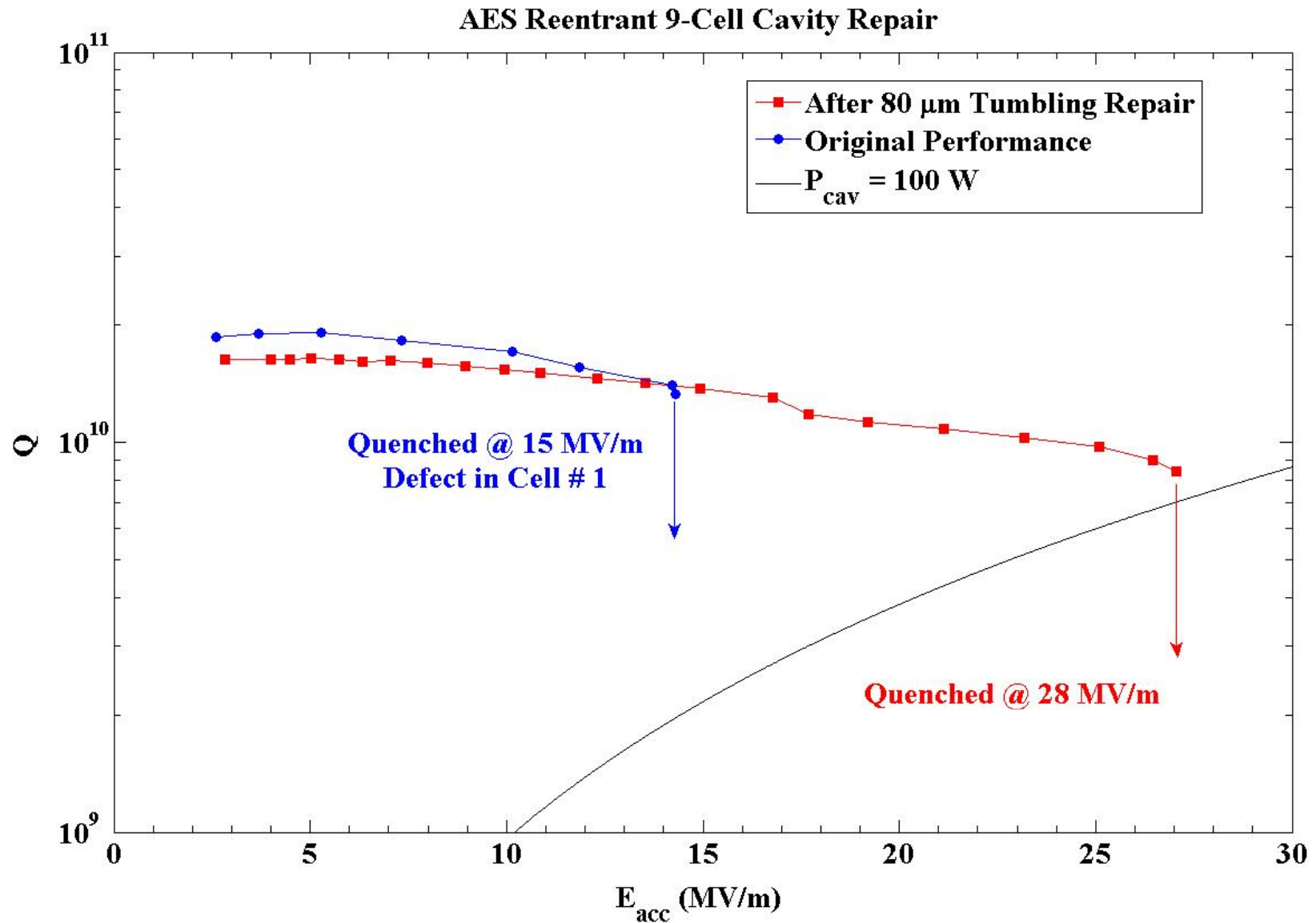


After Tumble Polishing LR9-1





After Tumble Polishing LR9-1





Summary and Plans

- Tumble polishing is a quick and useful technique to fix pit defects. It is cheaper and simpler than centrifugal barrel polishing but it does not remove material as fast (only $20\mu\text{m}/\text{day}$ with regular media replacement).
- We have successfully employed tumble polishing to repair pit defects.
- Tumble polishing coupled with chemical surface polishing is effective at producing high Q and high gradient cavities.