Comparison of Buffered Chemical Polished and Electropolished 3.9 GHz Cavities*

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Abstract

Five 3.9 GHz 9 cell cavities have been measured for the DESY FLASH module. These cavities were BCP processed and reached gradients of typically about 25 MV/m with Q drop starting at about 20 MV/m. Recently a few one cell cavities have been processed with EP and at least one has tested to a gradient of 30 MV/m with Q drop starting at about 25 MV/m. We will compare the results and give an update to the thermal analysis in relation to global thermal breakdown at 3.9 GHz.

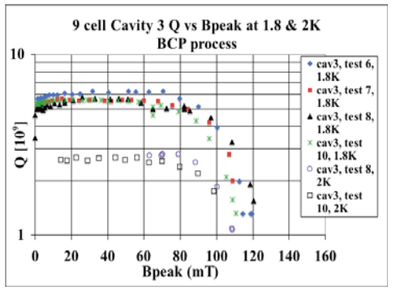
Parameter	*3.9 Ghz 9 cell*	*3.9 Ghz 1 cell*
Ep/Eacc	*2.26*	*1.99*
Bp/Eacc(mT/MV/m)	*4.86*	*5.86*
G1 (ohm)	*275*	*317*
Active length (m)	*0.346*	*0.0384*
R/Q (ohm)	*750*	*50.5*
Input coupler port & HOMs	*yes*	*no*
Wall thickness (mm)	*2.6*	*2.6*

Thermal model
Kapitza Conductance

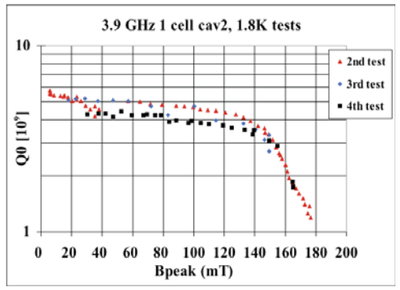
$$h_{Kap}\left[\frac{W}{cm^2K}\right] = A\left(T_{bath}\left[K\right]\right)^B \; f \;\; f\left(\frac{\Delta T}{T_{bath}}\right) = 1+\frac{3}{2}\left(\frac{\Delta T}{T_{bath}}\right)+\left(\frac{\Delta T}{T_{bath}}\right)^2+\frac{1}{4}\left(\frac{\Delta T}{T_{bath}}\right)^3$$

	identify	*A*	*B*
Mittag anneal Nb2	*Mit ann*	*0.020*	*4.65*
Amrit etch #1	*Amr#1*	*0.0935*	*3.55*
Amrit anneal, etch #3	*Amr#3*	*0.062*	*3.95*

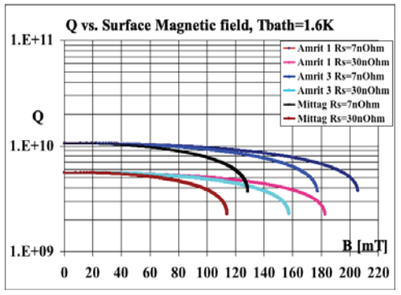
9 cell



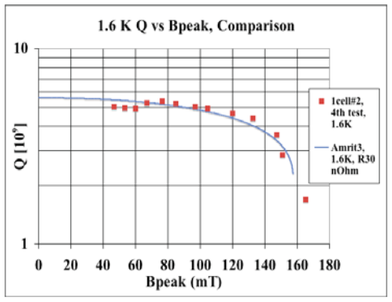
1 cell

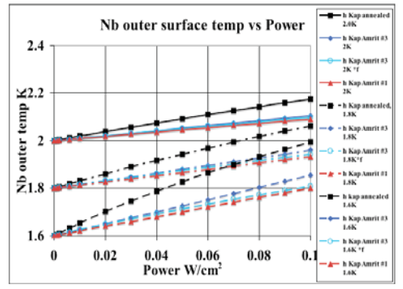


Model

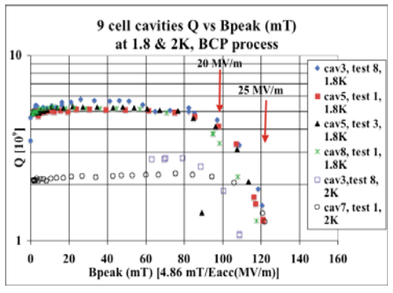


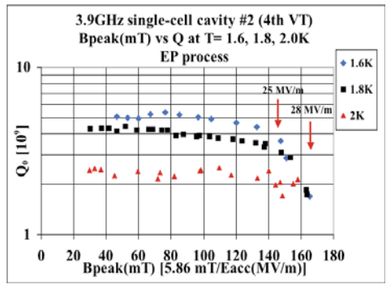
Comparison

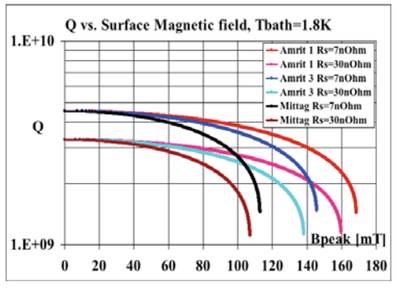


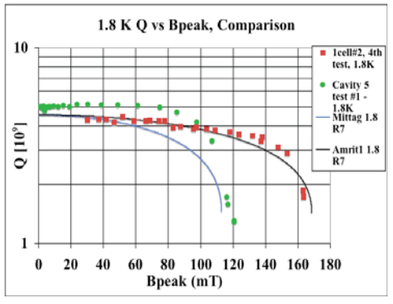


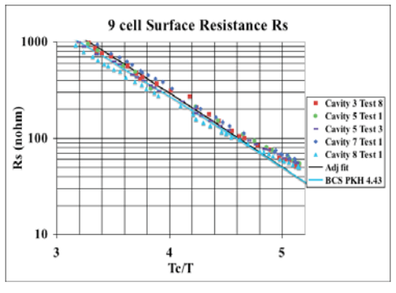
Thermal conductivity k[W/cm-K]= 0.3, 0.5
Assumed ~ constant





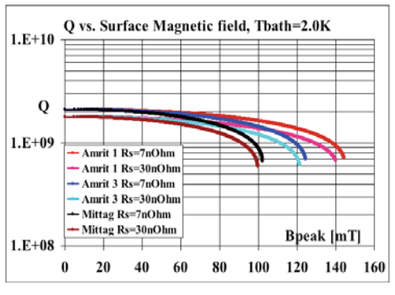


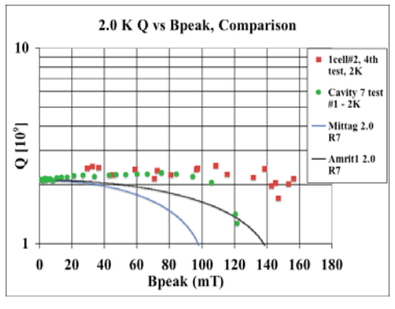




$$Rs[nohm] = A\frac{1}{T}\exp\left(-(B/T)\right) + R_{res}$$

where A= $1.35*10^5$ and B=17.67 are from Padamsee et al equation 4.43.





Summary

EP 1 cell measured to higher Bpeak than BCP 9 cells. Difference similar to 1.3GHz cavities.

Thermal models with high Kapitza and thermal conductivity indicate potential of reaching high Bpeak in 3.9 GHz cavities.

Some indication that thermal model has greater Q slope than measured cavities.

More EP data necessary and direct comparison with BCP and outside surface preparation.

Better thermal property data for specific material needed.

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