Note on Vertical Test Results of Cavity TE1ACC002-2

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Cavity TE1ACC002, a single-cell Tesla-shape cavity manufactured by ACCEL was initially tested at the Fermilab VCTF on 2/4/09. Results from that test indicated that the cavity was limited by strong field emission, beginning at about 21.5MV/m, and only reached 33 MV/m, accompanied by strong Q-drop. It was felt that the cavity performance would benefit from an additional HPR cycle, to eliminate/reduce the FE. After testing, the cavity was returned to the ANL/FNAL processing facility, where it underwent an 10 minute ethanol rinse, followed by a 110minute HPR cycle. The cavity was then assembled, evacuated, and leak checked, before being transported back to FNAL, to the VCTF at IB1, where it was mounted on the test stand, connected to the pumping system, and instrumented with the prototype single-cell diode thermometry system.

The cavity was cooled down from 4K to 2K, and some Q_0 vs T measurements were performed in the temperature region just above the λ-point transition. Once at 2.00K, CW measurements of Q_0 vs E were performed. The cavity low-field Q_0 was $1.7\text{x}10^{10}$ and showed mild Q-slope until ~25-26MV/m, where a strong Q-drop was observed. The cavity reached a maximum gradient of 31.3MV/m, limited by RF power (see Figure 1). The Q_0 had decreased at that point to $8.9 \text{ x } 10^8$, yielding a power dissipation of 127W, with an input power of 243W.

No field emission or other electron activity was observed during this test, indicating that the latest HPR/ethanol rinse process cycle had indeed successfully removed the surface contaminants that led to the strong FE behaviour during the previous test. However, the strong Q-drop seen it he earlier test remained, indicating that it is not due to FE loading but another loss mechanism (see Figure 2). Additionally the maximum gradient reached was slightly lower during this test (by about 2MV/m, or 6%). While this is within the measurement error (~ 2.5MV/m at that gradient level), it can not be ruled out that it is an artifact of the EtOH/HPR rinsing process, which somehow increased the loss mechanism responsible for the strong high field Q-drop. As was the case with the recent test of cavity TE1AES005, the performance of cavity TE1ACC002 may be improved by a 120º C bake, which would likely reduce or eliminate the Q-drop.

After CW measurements were performed at 2K, the He bath was pumped down to reach a temperature of 1.54K while Q_0 data were taken. From measurements of Q_0, we calculate a residual surface resistance of $4.1 \pm 0.2\text{n}\Omega$ at 1.54K (see Figure 3). This is consistent with R_s measured recently for other single cell cavities (2-7 nΩ).

Diode thermometry was mounted to this cavity and scans were performed at various times during Q_0 vs E runs at 2K. Those results will be reported elsewhere.

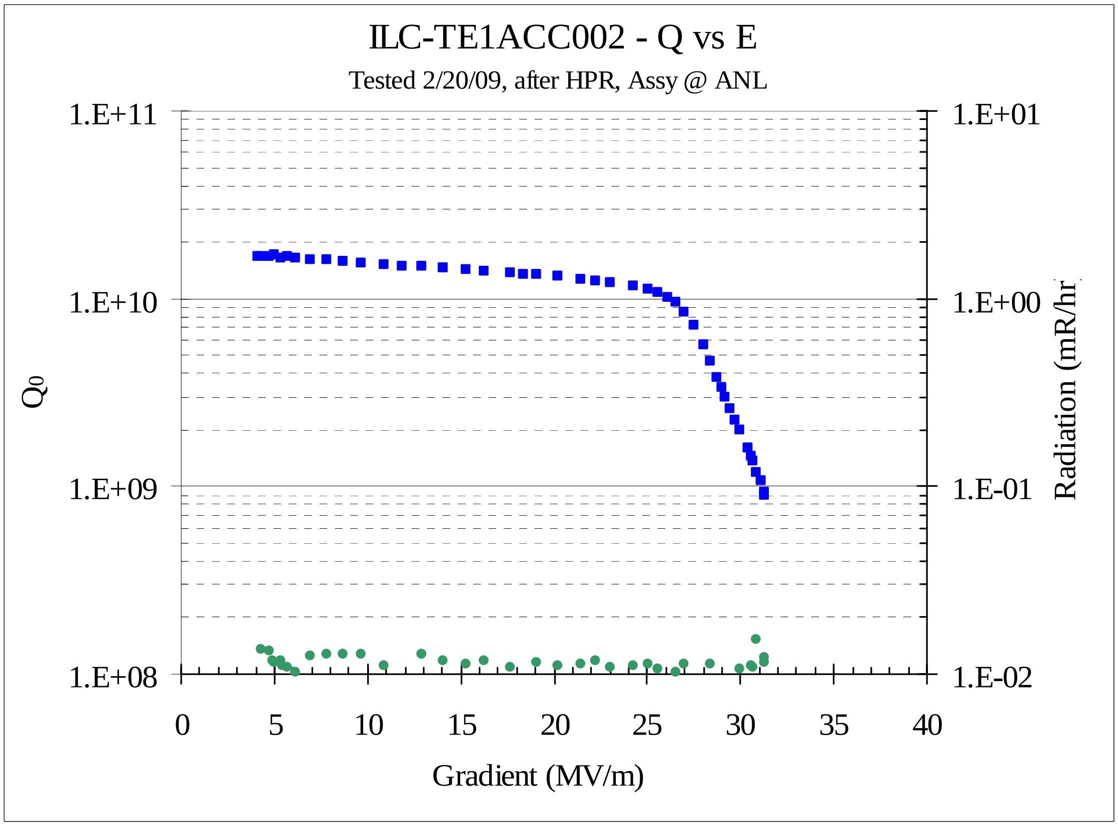

Figure 1.) Q_0 vs E run at 2K

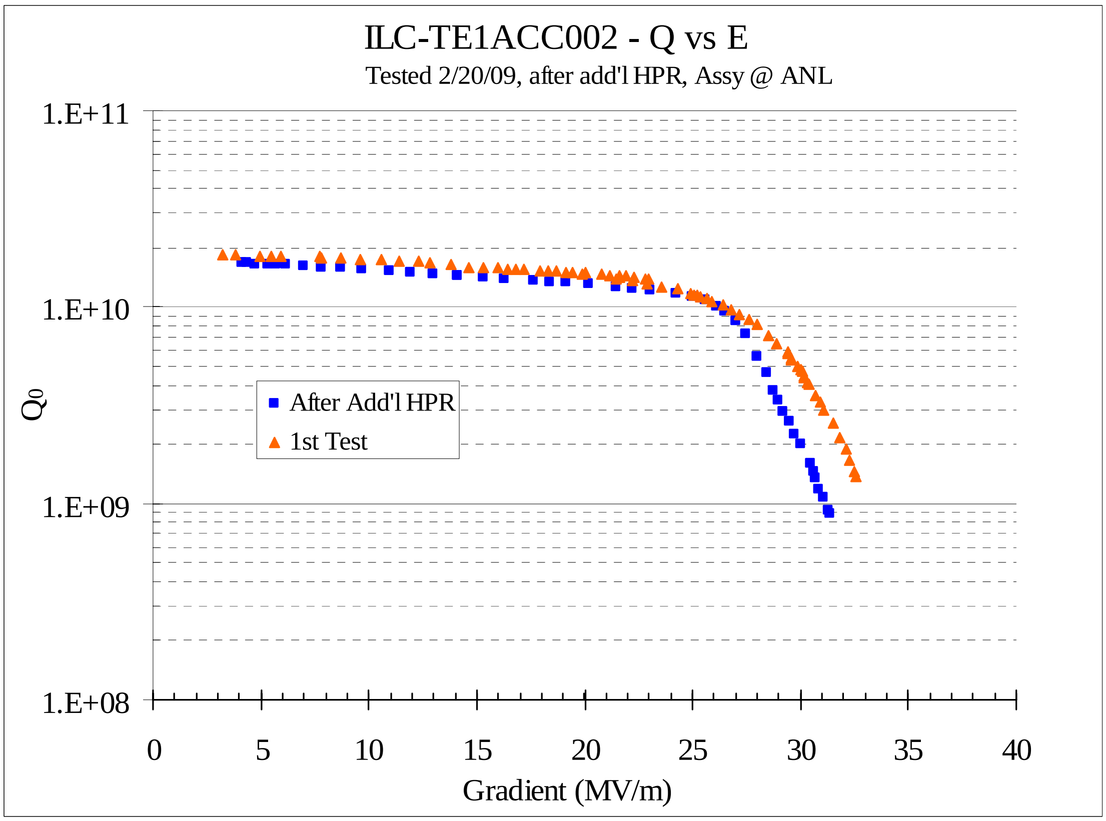

Figure 2.) Comparison of latest and previous Q_0 vs E runs at 2K

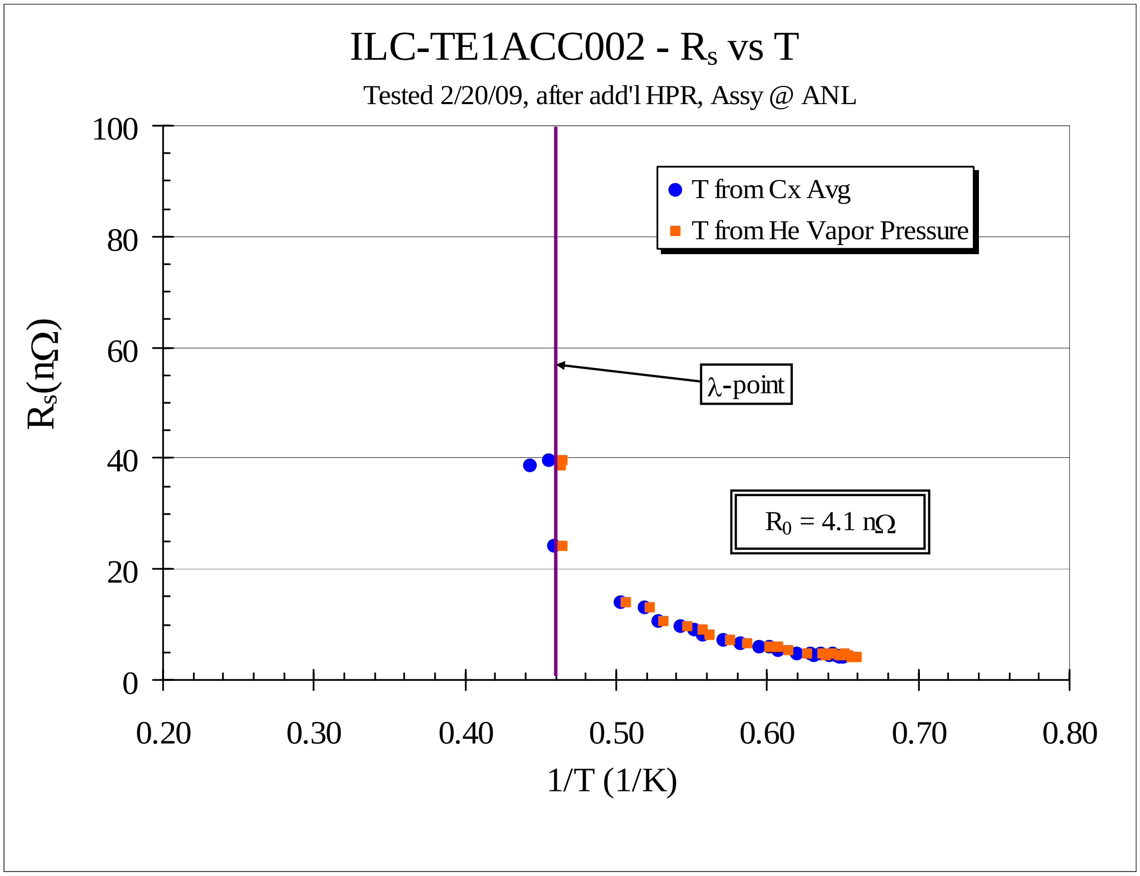

Figure 3.) R_s vs 1/T yielding a residual resistance of 4.1 ± 0.2 nΩ