Note on Vertical Test Results of Cavity TE1ACC004

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Cavity TE1ACC004 is a single-cell Tesla-shape cavity manufactured by ACCEL. It was used as part of a processing experiment wherein bulk chemical surface treatment was replaced by a mechanical tumbling process. In this process, about 100-120 μm of material was removed from the inner surface. Afterwards, an additional ~40 μm was removed using EP. The cavity was then US cleaned, rinsed, HPRd' and assembled at ANL. It was then tested at A0, but its performance could not be ascertained; very low Q values were calculated from the RF power measurements.

The cavity was then sent to JLab for a H-degassing oven treatment at 800° C for 3hours, after which it was returned to FNAL/ANL, for an additional 20 μm EP surface treatment, followed by the standard HPR and assembly cycle. Once the cavity was mounted the test stand at IB1 and hooked up to the pumping system, it was baked at approximately 120°C for about 36-40 hrs. The actual time and temperature of the bakeout is not well known due to the use of a non-standard heater element, which tripped the heater control unit and interrupted the bakeout for several hours. After the cavity was baked, it was inserted into the Dewar and a cooldown begun.

The cavity was cooled down from 4K to 2K, and some Q_0 vs T measurements were performed in the temperature region just below the λ-point transition. Once at 2.00K, CW measurements of Q_0 vs E were performed. The cavity's field probe was calibrated at field levels of about 4.9MV/m, and yielded a value of $3.47 \pm 0.03 \times 10^{12}$ (Q_2). The decay measurements (τ) used to calculate Q_2 were within 0.7% of each other, and the calculated values of Q_2 were consistent to within 0.8%. The input coupling was determined to be 7.9×10^9 (Q_1), and the cavity remained overcoupled throughout the test.

Low field Q_0 was found to be about 2.5×10^{10} at gradients between 4-6 MV/m, and decreased gradually as field increased. The cavity reached a gradient of 40.5 MV/m, limited by a hard quench. The Q_0 at this quench limit was 9.5×10^9 (see Figure 1). There was no indication of radiation above background; the cavity performance was FE-free. At this maximum field, P_{input} was 22.3.W, with P_{loss} about 22.0W, with the cavity near critically-coupled (P_{ref} was 0.3W, P_{trans} was 0.06W).

After performing Q_0 vs E measurements at 2.00K, the bath temperature was lowered by pumping on the Dewar, and Q_0 measurements were performed as a function of temperature (Figure 2). The residual surface resistance was found to be about 4.5nΩ - a very good value.

The performance of this cavity was indeed quite good, and in fact, surprising given that the appearance of the cavity interior suggested otherwise. It would be worthwhile to re-test this cavity with thermometry on the equator so that a quench origin can be determined, and then compared to results from optical inspection.

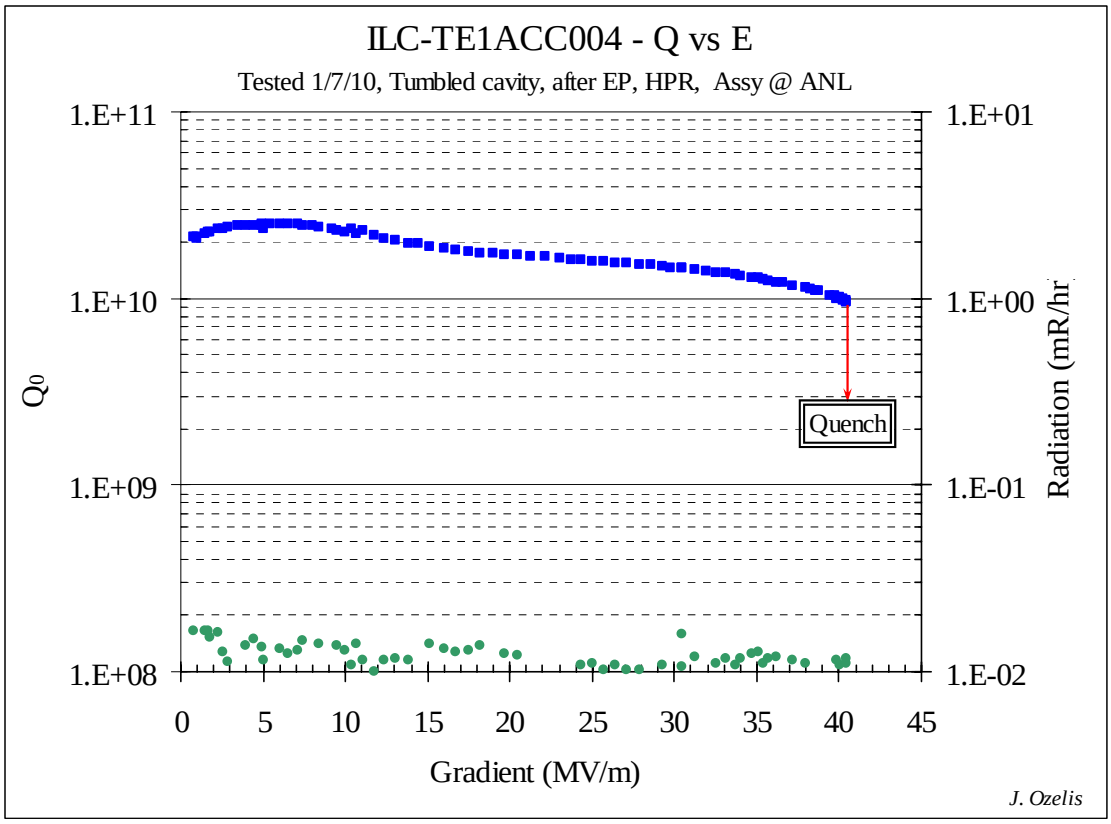

Figure 1.) Q_0 vs E run at 2K

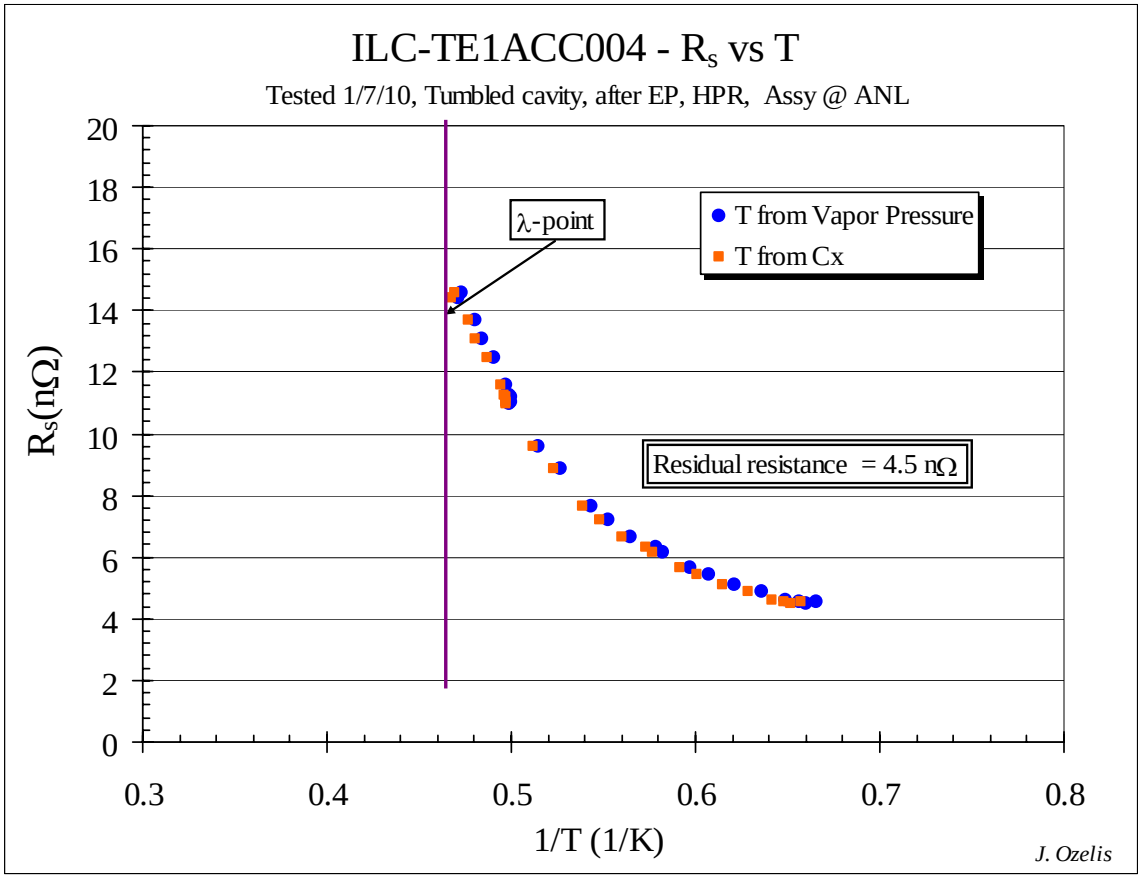

Figure 2.) Surface resistance as a function of temperature.