

FABRICATION, TUNING, TREATMENT AND TESTING OF TWO 3.5 CELL PHOTO-INJECTOR CAVITIES FOR THE ELBE LINAC

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INTRODUCTION

As part of a CRADA between HZDR and TJNAF we have fabricated and tested two modified 1.3 GHz 3.5 cell photo-injector cavities from polycrystalline RRR niobium (FG) and large grain RRR niobium (LG), respectively.

FABRICATION & TUNING

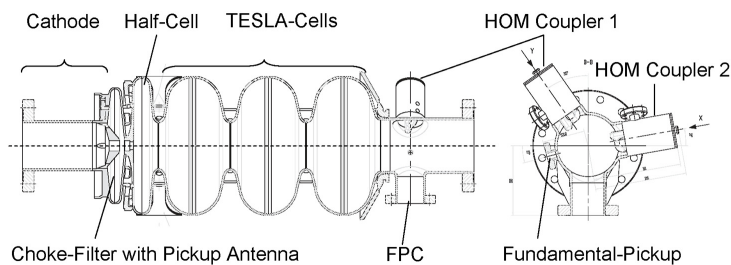


Fig. 1: Cross-section view of the modified SRF-Gun cavity.

Measurements and Tuning after Fabrication as in Ref. [1]

- Field- and frequency tuning of π -mode
- Q_{ext} measurements of all input and output antennas
- Tuning of choke-filter and HOM couplers (for $Q_{\text{ext}} > 10^{12}$)
- Identification of TE – modes for TE-mode focussing using inductive coupling loop and bead-pulling (see Fig. 2)

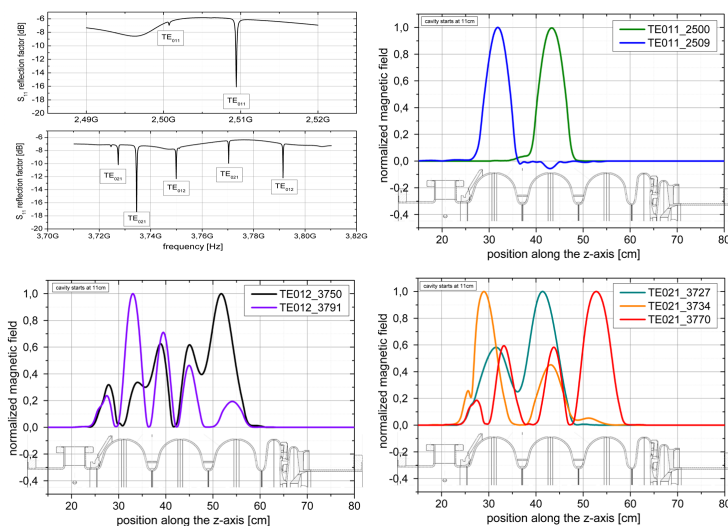


Fig. 2: Measured frequencies (upper left) and normalized field-distributions of potential TE-Modes for magnetic RF-focusing.

TREATMENT & DEFECTS

- 50 μm BCP (1:1:2 solution of $\text{HF}:\text{HNO}_3:\text{H}_3\text{PO}_4$)
- Hot water and high pressure ultrapure water rinsing
- Major challenge turned out to be the rinsing of the choke**
- Assembly of auxiliary parts and cold test
- Additionally 120 °C annealing prior some tests
- Poor performance in the first test because of similar defects at the turned endplate of the half-cell in both cavities



Fig. 3: Endplate after first treatment when defects appeared. Reason still unknown but maybe caused during turning of the large grain endplates.

CRYOGENIC TESTING

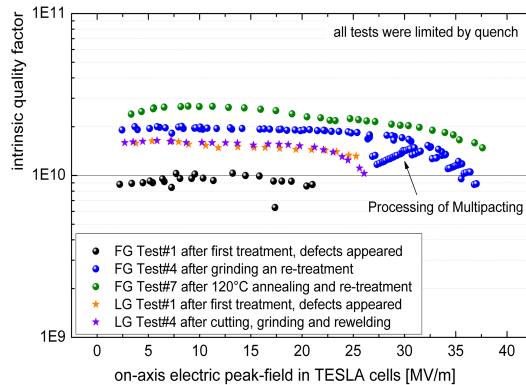


Fig. 4: Summary of significant cold tests @ 2K of both cavities. Final LG test is still pending.

- Identification of quench locations by second sound, optical inspection and field measurements of the pass band modes.

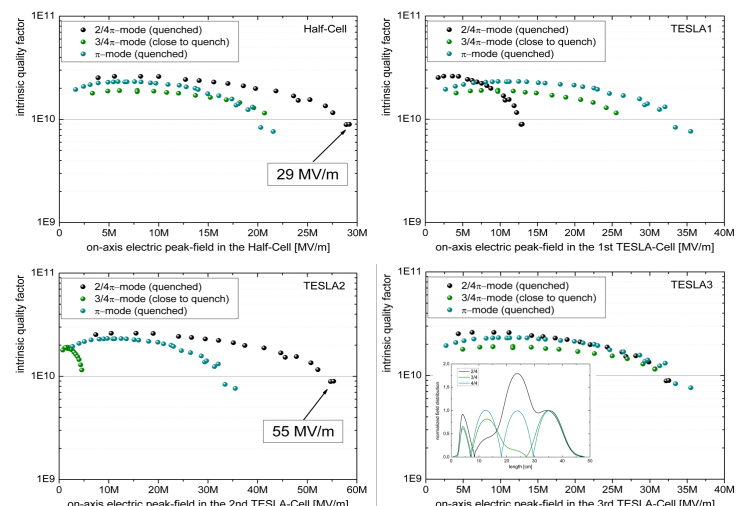


Fig. 5: Quench localisation during FG test#6 using field measurement. All modes are limited by last TESLA cell, where a small defect was found during optical inspection.

Acknowledgement

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References

- A. Arnold et al., "1st RF-Measurements @ 3.5-cell SRF-Photo-Gun Cavity in Rossendorf", Proc. Of FEL 2006, BESSY, Berlin, Germany.