Abstract

About 50 nine-cell cavities of the recent fine-grain niobium cavity productions have been analysed with respect to maximum and usable gradient in the first and final vertical acceptance test, respectively. Parameters of the analysis were the manufacturer of the cavities, the location of the main EP (=> industry or in-house), the final surface treatment (=> final 40µm EP or short 10µm "Flash" BCP) and the cavity preparation strategy (=> vertical acceptance test with or without He-Tank welded). Moreover, the effect of a re-processing of field emission loaded cavities by additional ultrapure high pressure water rinsing has been investigated.

Baseline of analysis
- About 50 cavities of 4th and 6th production analyzed
- Cavity preparation strategies:
  - "without He-Tank"; He-tank welding after preparation process + vertical RF acceptance test
  - "with He-Tank"; modified preparation strategy

Final EP Scheme
- BCP Flash Scheme
- EP 14µm
- EP 14µm
- Cavity cleaning
- Standard high pressure water rinse
- Flange assembly
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Max. gradient of cavity vendors
- Maximum gradient of last vertical RF test
  => Early quench of some Zanon cavities

Max. gradient depending on Main EP location
- Maximum gradient of last vertical RF test
  => no dependence on main EP location

Typical Q(E)-performances
- Yield plot for gradient of max RF test:
  - Maximum gradient of last vertical RF test
  - Vertical RF acceptance test with or without He-tank
  - First vertical RF test (=> goal for XFEL)
  - Field emission limits (limited by Zanon cavities + field emission)

Maximum and usable gradient depending on final treatment (final EP vs. final "Flash BCP")
- Analysis of about 15 – 25 cavities per treatment
- For 10 cavities only one test done => first + last test identical
  => yield for 23.6 MV/m (usable): (70 – 80)% in last test
  (50 – 60)% in first test
  (limited by Zanon cavities + field emission)
- Maximum gradient: Final EP with obvious high potential for gradients > 30-35 MV/m
- Usable gradient: Field emission at high gradients levels advantage of final EP

Summary
- Broad scatter of max. and usable gradient in vertical acceptance test:
  => some Zanon cavities with early quench
  => field emission limits in about 1/3 of tests
  => yield of usable gradient at 23.6 MV/m: 50 – 80 %
  => higher yield of final EP for gradients > 30 MV/m
- Industrialization of Main EP successful
- Re-processing with only HPR effective against field emission
- Optimized preparation scheme "with He-tank" successful
- Q-slope w/o field emission not fully cured by "120C bake"