New improved horizontal electropolishing system for SRF cavities

C.E. Reece†, S. Castagnola, P. Denny, and A. Mitchell
Thomas Jefferson National Accelerator Facility, Newport News, Virginia 23606, USA

Abstract

• Best niobium SRF cavity performance is obtained with surfaces smoothed by electropolishing (EP).
• Jefferson Lab has recently specified, procured, installed, and commissioned a new versatile production electropolishing (EP) tool.
• Detailed design and fabrication was awarded to Semiconductor Process Equipment Corporation (SPEC). The delivered system was integrated into the JLab chemroom infrastructure and commissioned in 2020.

Features of the new system
• Remote H₂SO₄/HF electrolyte acid sump with improved heat exchanger.
• Safer provisions for adding HF to the sump.
• Reduced labor requirement per cavity cycle.
• Improved safety and ergonomics.
• Robust PLC control.
• Cavity external cooling – uses UPW spray with available chilling. Unobstructed spray from above with sheeting flow over the cavity surface.
• Power supply provides 0–20 V DC and up to 250 A.
• Seven wireless readout thermocouple sensors to monitor temperature at several cavity locations.
• Stabilized cavity process temperature ≥ 5 °C

• Takes advantage of Test Lab infrastructure with generous glycol chilled water and ultrapure water systems.
• Yields confident, uniform temperature regulation for uniform removal.
• Two days of operating parameter studies in August 2020 using 952 MHz 5-cell cavity.
• Simple operation modes identified for routine selectable 5 °C, 13 5 °C, and 21 °C options.

Summary

A new system for electropolishing niobium accelerator cavities has been developed, installed, and commissioned at Jefferson Lab. Its design takes advantage of the community’s lessons learned and is now providing reliable well-controlled processing conditions for several construction and research projects.

Note that on this date the electrolyte was already significantly depleted of HF, so current was lower than expected with fresh acid.

With stabilized temperature, the system I-V curve demonstrates the “plateau” polishing domain for the 952 MHz cavity test configuration.

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† reece@jlab.org