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Development of High-Q SRF Structures by Nitrogen Doping for Superconducting Electron Linacs

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2017-0039

Fermilab Technical Contact: Anna Grasselino

Summary Report
30 September 2019

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CRADA number: FRA-2017-0039

CRADA Title: Development of High-Q SRF Structures by Nitrogen Doping for Superconducting Electron Linacs

Parties to the Agreement: Niowave, Inc. and Fermi Research Alliance, LLC

Abstract of CRADA work:

One of the most exciting recent developments in superconducting RF technology has been the discovery of a nitrogen-doping process which can reliably increase the superconducting quality factor of niobium resonators well above 10^{10} at high frequency (>1 GHz). This process is now well demonstrated in particular for TESLA-style 9-cell cavities at 1.3 GHz. Nitrogen doping can significantly increase efficiency of the cavities as well as the cryogenic efficiency accelerators, and allowing significant capital cost reductions. This project will expand the application of nitrogen doping into the low-frequency regime and investigate and quantify effects on the quality factor in low frequency superconducting structures from the nitrogen doping process.

Summary of Research Results:

Phase I of this STTR project has focused on the requirements to adapt Niowave's commercial superconducting cavity designs to be compatible with the nitrogen-doping process developed at Fermilab. An existing niobium resonator was delivered to Fermilab for examination by the team currently performing nitrogen doping of 9-cell structures for LCLS-II. Commercial superconducting cavities use several types of materials that are not compatible with the Fermilab vacuum furnace. During Phase I, the vacuum flanges for a Niowave 350 MHz resonator were redesigned and a power coupler antenna and pickup antenna were designed that will allow the cavity to enter the vacuum furnace at Fermilab and also to be tested at cryogenic temperatures.

Related Reports, Publications, and Presentations:

None

Subject Inventions listing:

None

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Report Date: 30 September 2019

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