FERMILAB-CRADA-FRA-2013-0004

Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Characterization, Polishing & Testing of Stainless Steel Hemofiltration Cartridge Prototypes for Vanderbilt University

Cooperative Research and Development Agreement Final Report

CRADA Number: FRA-2013-0004

Fermilab Technical Contact: Charlie Cooper

Summary Report
29 July 2019

Fermi National Accelerator Laboratory / Kirk and Pine Street / P.O. Box 500 / Batavia, IL 60510 / 630.840.3000 / www.fnal.gov / fermilab@fnal.gov
Managed by Fermi Research Alliance, LLC for the U.S. Department of Energy Office of Science

Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.

NOTICE

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA number: FRA-2013-0004

CRADA Title: Characterization, Polishing & Testing of Stainless Steel Hemofiltration Cartridge Prototypes for Vanderbilt University

Parties to the Agreement: Vanderbilt University and Fermi Research Alliance, LLC

Abstract of CRADA work:

Vanderbilt University has developed a stainless steel Hemofiltration Cartridge prototype. It is required that these cartridges be polished to the highest degree possible. Fermilab has expertise in polishing niobium cavities for High Energy Physics applications. This Cooperative Research and Development Agreement will be the first step to determine if the techniques used to polish niobium cavities can be applied to the prototype cartridges.

Summary of Research Results:

Dr. William Fissel from Vanderbilt University developed a stainless-steel design for an implant for an artificial kidney which would ultimately be made from niobium due to its biocompatibility. Fermilab provided expertise at polishing to ensure there was no pitting of material in the flow path located inside the implants that is several mms in diameter. The flow path cannot be accessed externally except at the entrance and exit to the flow path. Pitting in the blood flow path can lead to unwanted growth and clotting. At the time of development, it was not possible to 3D print niobium, therefore Vanderbilt sent two prototypes made from stainless-steel to Fermilab for polishing.

Throughout the polishing process, Fermilab pumped various abrasive medias suspended in solution through the prototype. Stainless steel is much harder than niobium and initial trials to polish the flow path were unsuccessful. To better judge what specifications were needed to properly polish the interior flow path, Fermilab test polished one outside surface. The surface is extremely rough, and a very course polish was initially needed to remove on the order of 400 microns before fine polishing could be done. Upon finishing fine polishing, Fermilab noticed significant pitting of the stainless-steel surface even after repeated polishing. Pit sizing identified after polishing were on the order of 25 to 150 microns in size throughout the material.

Based on current cutting-edge technologies in 3D printing of stainless steel, Fermilab and Vanderbilt University could not remove pitting or imperfections in the material to the point where the prototypes could be used for the testing required for medical use. Because of this there was no interest to continue the work.

The conclusion of the work indicated that a redesign of the device may be needed to account for polishing of the flowpath.

Related Reports, Publications, and Presentations:

No formal reports, publications or presentations were openly reported on this work. Informally, progress reports including SEM pictures showing the level of polishing and the pitting in the material were provided to the customer after testing.

Subject Inventions listing:

No subject inventions were identified in the course of the work.

Report Date: 7/29/2019

Technical Contact at Fermilab: Charlie Cooper

This document contains NO confidential, protectable or proprietary information.

Click here to enter text.