Cooperative Research and Development Agreement (CRADA) Final Report

Report Date:
12/2/2021

In accordance with Requirements set forth in the terms of the CRADA, this document is the CRADA Final Report, including a list of Subject Inventions. It is to be forwarded to the DOE Office of Scientific and Technical Information upon completion or termination of the CRADA, as part of the commitment to the public to demonstrate results of federally funded research.
Parties to the Agreement: Funxion Wear Inc & Berkeley Lab

CRADA number: FP00009619

CRADA Title: Characterization of Multi-Material Interfaces Within Fibrous

Responsible Technical Contact at Berkeley Lab: Thomas Kirchstetter

Name and Email Address of POC at Partner Company(ies):
Raj Bhakta
rajbhakta@funxion.tech

Sponsoring DOE Program Office(s):
Advanced Manufacturing Office

LBNL Report Number:
LBNL-2001439

OSTI Number:
[SPO to complete]

Joint Work Statement Funding Table showing DOE funding commitment:

DOE Funding to LBNL	$100,000
Participant Funding to LBNL	$0
Participant In-Kind Contribution Value	$100,000
Total of all Contributions	$200,000

Provide a list of publications, conference papers, or other public releases of results, developed under this CRADA:
(Publications must include journal name, volume, issue, Digital Object Identifier)
N/A

Provide a detailed list of all subject inventions, to include patent applications, copyrights, and trademarks:
(Patents and patent applications are to include the title and inventor(s) names. When copyright is asserted, the Government license should be included on the cover page of the Final Report)
N/A

Executive Summary of CRADA Work:
This project aimed to characterize the electrical, ionic, and thermal material properties of printed materials onto various textile and leather substrates. Furthermore, the material interfaces were investigated as well via characterization techniques such as SEM, TEM, and FTIR for example. Results from these studies will be utilized to properly formulate and tune process variables for enhancing the durability of devices and mitigate risks during commercial scale manufacturing studies of interest to Funxion's product development.

Summary of Research Results:

Preliminary research for smart textile technologies was conducted over the period of this project. The primary focus was on characterization efforts for the following:

1. Metal-polymer interface of a printed device on flexible/stretchable substrates (textiles/leather)
2. Ionically conductive material embedded into a fibrous structure (textile/leather) via electrochemical studies
3. Interfacial adhesion, ionic conductivity of the polymer electrolyte for a thin-film coating compared to a thick-film embedded into fibrous structures (textiles/leather)
4. Thermal conductivity of devices with multi-material compositions and investigate the relationship of said materials' thermal transfer phenomena embedded into textiles/leather

The characterization research on these key areas has enhanced our ability to pursue further development of smart fabric based form factors for wearable remote health monitoring applications, wearable medical devices, and also for applications in the consumer realm for color changing apparel and fashion.

APPENDIX A (Reference Only)

*This appendix has been developed by DOE to assist DOE Labs in drafting the **Executive Summary** and **Summary of Research Results** sections of the CRADA Final Report.*

Executive Summary of CRADA Work:

Include a discussion of 1) how the research adds to the understanding of the area investigated; 2) the technical -effectiveness of the materials, methods or techniques investigated or demonstrated, and their economic feasibility, if known; and 3) how the project is otherwise of benefit to the public. The discussion should be a minimum of one paragraph and written in terms understandable by an educated layman.

Summary of Research Results:

- *INCLUDE, IF APPLICABLE: "This product contains Protected CRADA Information, which was produced on [DATE] under CRADA No. [##-####] and is not to be further disclosed for a period of [up to and not to exceed] five (5) years from the date it was produced except as expressly provided for in the CRADA."*
- *Summarize project activities for the entire period of performance, including original hypotheses, approaches used, problems encountered, any departure from planned methodology, and an assessment of their impact on the project results. Incorporate technical data, e.g. facts, figures, analyses, and assumptions used during the life of the project to support the technical conclusions of the work. It is acceptable to incorporate the technical data by reference to other publicly available sources, such as a publications or other reports, but not websites. Provide a comparison of the actual accomplishments with the goals and objectives of the project. Where possible, the summary should cover each task listed in the Statement of Work (SOW) and should note any deviations from the project plan, or lack of technical data.*
- *Identify products, potential applications, and technology transfer activities developed under the CRADA, including those completed and anticipated at the time of the report. These include, but are not limited to: 1) networks or collaborations fostered; 2) technologies/techniques/methodologies; 3) other products that reflect the results of the project, such as commercial products, internet sites, data or databases, physical collections, audio or video, software, models, educational aid or curricula, and instruments or equipment.*

Note: Recommended characteristics of Scientific and Technical Information reports can be found at https://www.osti.gov/stip/attributes