Project Summary

Title: A Novel Method of Molten Salt Electrodeposition of high-$T_c$ Superconducting Bismuth Based Nanowires and Nanotubes

Investigators: Despina Davis, Ph.D. (Louisiana Tech University) – PI
Institute for Micromanufacturing (IFM)
Chemical Engineering Department
911 Hergot Avenue, Ruston, LA 71272
Phone: 318-257-5142
Fax: 318-257-5104
E-mail: davis@latech.edu

Stephanie A. Getty, Ph.D. (NASA)
Materials Engineer-Nanotechnology
Materials Engineering Branch, Code 541
NASA – Goddard Space Flight Center
Bld. 30, Rm. 172 Greenbelt, MD 20771
Phone: 301-286-9760
Fax: 301-286-1646
E-mail: stephanie.a.getty@nasa.gov

Abstract

We propose the novel technique for the growth of superconducting (Bi1-xPbx)2Sr2Ca2Cu3O10+δ nanostructures from its molten salt electrolyte. The precursors of superconducting Pb, Sr and Ca will electrodeposited in an electrolytic bath prepared from the nitrate salts of the constituent metals in a molten state by heating above 550°C. The superconductor will be electrodeposited in the form of nanotubes and nanowires depending upon the substrate in use – polycarbonate or alumina membranes with different pore sizes. This novel technique will eliminate the process of oxidative thermal treatment in air and it will avoid the impure phase formation. The influence of melting temperature and the composition of the molten electrolytic bath will be studied and optimized to get the desired stoichiometry (2223 phase of superconducting Bi(Pb)-Sr-Ca-CuO). Characterization will be done using XRD for detecting the crystal structure, EDS and WDS for the elemental composition, SEM for qualitative measurements and PPMS for the transport properties of the electrodeposited nanostructures in the molten bath.

This is a collaborative research initiative: the nanotubes and nanowires fabrication will be carried out by the PI at Louisiana Tech University and the resistivity measurements will be supervised by Dr. Stephanie A. Getty at the NASA – Goddard Space Flight Center – Materials Engineering / Nanotechnology Branch.