Superconductivity News Update

Bringing New Power to Electricity

November 2009

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The High Temperature Superconductivity Program: Recent News!

INTRODUCTION

For FY2010, the Electricity Delivery and Energy Reliability Program does not call out specific funding for the High Temperature Superconductivity Subprogram. The High Temperature Superconductivity efforts and the former Visualization and Control Subprograms are now carried in a Subprogram called Clean Energy Transmission and Reliability.

The House-Senate conference committee has appropriated $171,982,000 for the Office of Electricity Delivery and Energy Reliability in FY2010, about $35 million more than in FY2009. The President signed the Energy and Water Development and Related Agencies Appropriations Act on October 28, 2009.

In addition, the American Recovery and Reinvestment Act added about $4.5 billion in grants, contracts, and loan guarantees, as follows:

FY 2009 Additional Appropriations - Electricity Delivery and Energy Reliability:
(dollars in thousands)

Smart Grid Investment Program: $3,375,700
Smart Grid Regional Demonstrations and completion of ongoing demonstration projects: $700,000
Interoperability Standards: $10,288
Workforce Development: $100,000
Interconnection Planning and Analysis: $80,000
Program Direction: $22,500
Other: $211,512
Total, Electricity Delivery and Energy Reliability $4,500,000

Details may be found at: http://www.energy.gov/recovery/infrastructurefunding.htm

The budget responds to President Obama's request for clean and reliable energy sources to enhance the United States' economic future. The budget also supports DOE Secretary Stephen Chu's strategy to support the President by developing a plan to stimulate the economy, save and create jobs, reduce the United States' dependence on foreign oil, cut carbon emissions, and address renewable energy and electric power transmission projects. Under the budget, the High Temperature Superconductivity (HTS) Program is addressed and declared necessary for the future of the United States electric transmission system and more specifically utilized within the "smart grid" framework.

Patricia Hoffman, Acting Assistant Secretary for DOE's Office of Electricity Delivery and Energy Reliability, spoke at the 2009 High Temperature Superconductivity Program Peer Review in August, where she reaffirmed that the HTS program is ready to support the administration's initiatives.

To view the complete budget request, please visit http://www.cfo.doe.gov/budget/10budget/Start.htm.

WHAT IS CHANGING IN THE HTS PROGRAM?

Currently, the HTS program falls within the Electric Delivery and Energy Reliability program. Under the 2010 budget, the HTS program will be included in a newly formed subprogram: Clean Energy Transmission and Reliability (CETR). The CETR is responsible for developing advanced transmission technologies to improve grid reliability, efficiency, and security. The program, which was created to address the expansion and modernization of the transmission system infrastructure and the integration of renewable energy sources, supports research and development in next generation cables and conductors to increase the load capacity of the current transmission infrastructure. CETR is also responsible for researching the mechanisms of transmission systems to enable greater understanding and response to the evolving system as well as market conditions.

WHAT ARE THE PRIORITIES OF THE DOE LABS?

The National Laboratories are doing their part to support the President's and Dr. Chu's initiatives by continuing and expanding their work in research and development of HTS applications. Their goals are to develop a low-cost, high-efficiency HTS cable that can carry electricity long distances and play a key role in the creation of the "smart grid." Other applications, such as HTS Fault Current Limiters (FCL), would enhance the "smart grid" by providing stability and protection. Following is a synopsis of the Laboratories' current efforts and how they play a key role in the development of HTS applications.

ARGONNE NATIONAL LABORATORY (ANL) http://www.anl.gov/

ANL's Superconductivity program in the Material Science Division and Electron Microscopy Center focuses principally on research and development of high temperature superconducting materials. Specializing in characterization, ANL's research provides the link between production processes and HTS performance. Insight gained from these studies is leading to the development of higher efficiency HTS wire and other applications.

Project details can be found at: http://www.msd.anl.gov/groups/em/index.php

Improving performance in 2G HTS wires produced by SuperPower

SuperPower's "helix" growth process

(Provided by ANL and Superpower, Inc.)

BROOKHAVEN NATIONAL LABORATORY (BNL) http://www.bnl.gov/world/

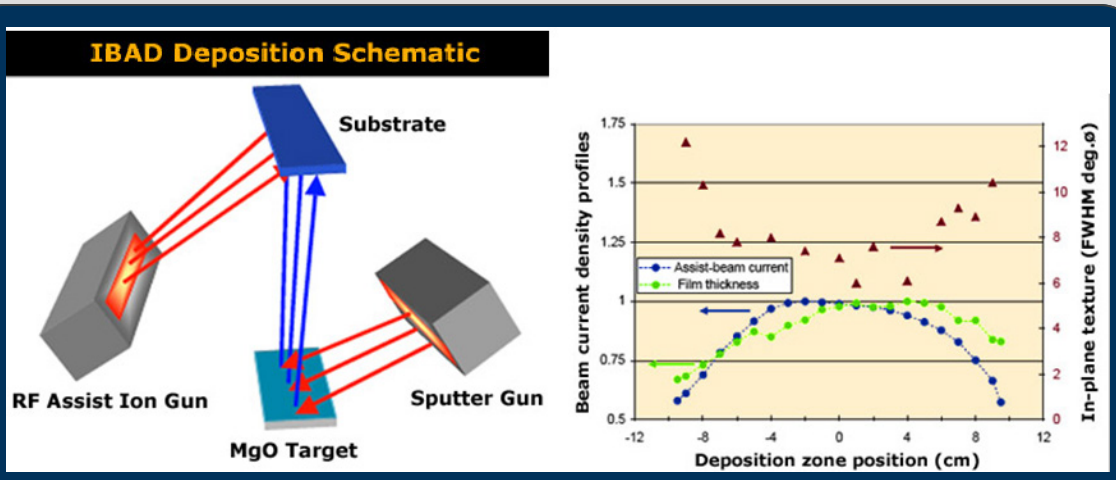
BNL's Condensed Matter Physics & Materials Science Department works with national laboratories, industry, and universities to research fundamental wire properties and the production issues inherent to large scale production. Their purpose is to understand the full potential and reduce the cost of 2G conductors through improvements in the structure of its layers. The Brookhaven team actively utilizes National Synchrotron Light Source (NSLS) for advanced structural studies of coated conductors.

Project detail can be found at: http://www.bnl.gov/cmpmsd/AdvancedEnergyMaterials/default.asp

LOS ALAMOS NATIONAL LABORATORY (LANL) http://www.lanl.gov/

LANL's Superconductivity Technology Center (STC) collaborates with industry, universities, and other national laboratories to develop second generation HTS wires based on the ion beam assisted deposition (IBAD) process developed by LANL and to measure and model AC losses in HTS conductors and systems. Other collaborative projects with industry include development of tapes, fault current limiters, and HTS power transmission cables.

Project details can be found at: http://www.lanl.gov/orgs/mpa/stc/index.shtml



(picture provided by LANL)

NATIONAL RENEWABLE ENERGY LABORATORY (NREL) http://www.nrel.gov/

NREL's High Temperature Superconductivity (HTS) program is directed at electrodeposition of stabilization layers and buffer layers for second-generation YBCO superconductor materials. Electrodeposition is a potentially low-cost, non-vacuum, high-rate deposition process that can easily deposit uniform film on large non-planar substrates. The primary objective of the program is the realization of electrodeposition of the Cu stabilization layer on YBCO superconductors coated with very thin Ag layer (~0.2 micron only). This work is performed in collaboration with SuperPower Inc., under a CRADA agreement. We are also developing simplified buffer-layer architecture for second-generation YBCO superconductors. Textured substrates, such as NREL's electrodeposited layers of Gd2O3 and CeO2 are used. NREL is collaborating with AMSC on textured buffer layer project."

Project details can be found at: http://www.nrel.gov/basic_sciences/technology.cfm/tech=9

Optimization of the electrodeposition conditions improved Cu deposit and eliminated Ic degradation

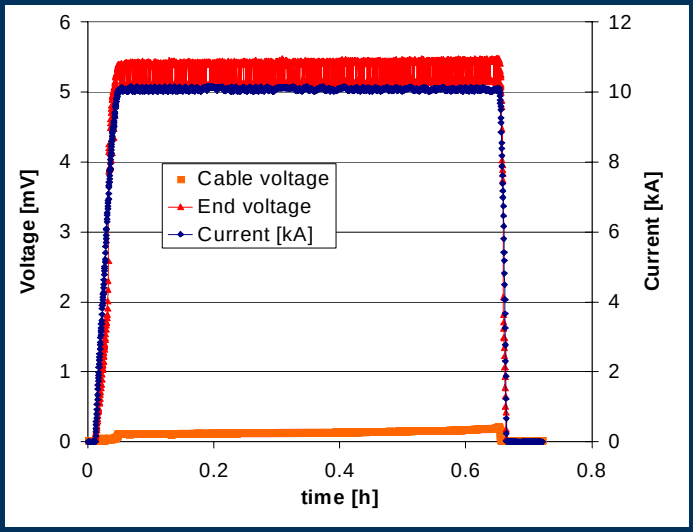
(Provided by NREL)

OAK RIDGE NATIONAL LABORATORY (ORNL) http://www.ornl.gov/

ORNL's Superconductivity for Electric Systems Program engages in the entire spectrum of DOE HTS research, development and demonstration (RD&D) activities; from basic Conductor Research to applied Wire Development to Novel and Enabling Technologies to HTS Applications. These RD&D activities include in-house research in nanoengineered defects and advanced Structural Single-crystal Faceted Fiber Substrate(recipient of a 2009 R&D 100 award) as well as continued support of wire manufacturers such as AMSC (http://www.htspeerreview.com/pdfs/presentations/day%202/2G/1-ORNL-AMSC-CRADA.pdf) and SuperPower (http://www.htspeerreview.com/pdfs/presentations/day%202/2G/4-MOCVD-IBAD-2G-Wire.pdf) as highlighted at the recent DOE HTS Peer Review. ORNL is also applying its expertise in the areas of cryogenic dielectrics, cryogenic systems and power system technology to develop high power AC and DC cables, fault current limiters and transformers. One of the highlights at the 2009 Peer Review was the demonstration of a short DC cable made with 2G conductor that operated at a current of 10 kA and a voltage of 60 kV dc (the equivalent of nearly 600 MVA power).

Project details can be found at: http://www.ornl.gov/sci/oetd/superconductivity.htm
http://www.ornl.gov/sci/htsc/research.html

1. Cable set-up for test at 60 kV dc



2. DC cable operation at 10kA for over 30 minutes

(pictures provide by ORNL)

SANDIA NATIONAL LABORATORIES (SNL) http://www.sandia.gov/index.html

SNL develops advanced superconductors based on chemical solution deposition processes. Its goal is to extend low-cost coated conductors based on high-rate, all-solution deposition to pilot plant production of 10 m-1 km lengths. Sandia has unique capabilities in chemical solution deposition (i.e. sol-gel processing, metal-organic decomposition, inkjet printing, aerosol spray) and materials processing capabilities to enable solution deposition planarization (SDP), epitaxial oxide film deposition, and electrical ceramic film processing, optimization, and scale-up. Sandia has an ongoing cooperative research and development agreement (CRADA) with Zenergy Power Inc., and joint research with Los Alamos, Superpower, and STI.

Project details can be found at: http://www.sandia.gov/materials/science/capabilities/thin-film.html

JOB CREATION

The National Labs ORNL and LANL are creating jobs by establishing cooperative agreements with industry leaders to manufacture HTS tapes. Their goal is to assist industry in manufacturing large-scale long-length HTS tapes. The National Labs offer industry the opportunity to work in their facilities, and utilize lab researchers while allowing them to keep their trade secrets confidential in an effort to enhance cable production processes. By increasing production and perfecting manufacturing processes, the costs to produce HTS cables should lower and become competitive with other products. Ultimately, when the HTS cables establish large-scale production, this, too, will create jobs.

The Department of Energy's HTS Cable projects are also creating and sustaining jobs. DOE's successful HTS Cable projects in Carrolton, GA, Albany, NY, Columbus, OH, and Long Island, NY have provided jobs in the areas of manufacturing, installation, and maintenance. Recently, DOE established grant money to develop a new cable project in New Orleans. This, will also, establish new jobs in the areas of siting, manufacturing, installation, and maintenance. The New Orleans project will solve a real-world electrical load problem; specifically, eliminating congestion on the power grid caused by high demands for electricity. The cable project will also demonstrate commercial viability for long-length HTS cables in a utility grid.

REDUCE CARBON EMISSIONS

HTS applications are environmentally friendly compared to conventional copper cables. They operate more efficiently, thereby require less power generation with the associated Greenhouse gasses. In addition, they are cooled by liquid nitrogen as opposed to flammable and toxic oil coolants.

INTEGRATION OF GREEN ENERGY SOURCES

Direct current (DC) superconductor cables significantly reduce loss of energy during transmission, thus making them an excellent choice in the modernization of the grid. The Obama administration has asked for an increase in the integration of renewable resources into the grid while reducing the environmental impact. The DC superconducting cables meet this request by providing a way to deliver large amount of energy long distances, with minimal energy losses. This means they could connect to renewable energy sources that are located in remote areas. They also provide minimal impact to the environment because the cables are placed underground on existing rights-of-way.

CONCLUSION

The Clean Energy Transmission and Reliability program is ready to support the Obama administration's as well as Secretary Chu's initiatives. They will continue to develop high efficient, low-cost Superconductor cables and applications to assist in the expansion and modernization of the transmission system infrastructure as well as the integration of renewable energy sources. CETR will continue research on superconducting cables and associated technologies to increase the load capacity of the current transmission infrastructure.

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ABOUT THIS UPDATE

The High-Temperature Superconductivity News Update is compiled by Bob Lawrence & Associates Inc. on behalf of the Department of Energy's superconductivity program and is issued periodically as events warrant. Current and past issues are available at http://www.superconductivitynewsupdate.com/.

Please let me know if you would like more information or story ideas on any of these news items involving high-temperature superconductivity---a clean and capable new electricity technology for the 21st century. If you have any other comments or questions, please let me know.

Thank you very much.

Jodi Hamrick

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