
Project Title:	Cost Effective, Open Geometry HTS MRI System
Organization(s):	Oxford Instruments Superconducting Technology (OST)
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FY 2003 Funding:	\$606K (DOE), \$606K (Industry), \$150K (LANL), \$200K (NREL)

Project Purpose and FY 2003 Objectives: The purpose of this Phase II Superconductivity Partnership Initiative project is to build and operate a prototype Magnetic Resonance Imaging (MRI) system using HTS coils wound from low-cost, dip-coated BSCCO 2212 tape conductor. This effort started this fiscal year. Specific objectives for FY 2003 are to (1) achieve powder reliability, lot reproducibility, and cost reduction through precursor materials and processing facility changes; (2) finalize conductor design for this application; (3) design and begin fabrication of prototype conductor processing line; (4) begin design of cryogenics system and magnet.

FY 2003 Performance and FY 2004 Plans: Powder precursor changes have been made, and qualification trials underway show performance improvements in addition to cost reductions. Significant powder process facility improvements are underway with completion expected this fiscal year. Several key conductor design parameters were identified and optimized. Three different conductor configurations were fabricated and evaluated in an effort to achieve minimum dollars per kiloamp-meter. Significant opportunities to improve the conductor were identified and are now being pursued. A prototype coating line was designed and is under construction; final design of a prototype heat treatment line is awaiting down selection of conductor configuration. Magnet modeling and design work is underway.

For FY 2004 plans include (1) Complete qualification of lower cost powder and powder processing upgrades. (2) Complete prototype conductor processing line and qualify the process. (3) Partial conductor fabrication. (4) Complete cryogenics and magnet designs.

FY 2003 Results: Key results from the FY 2003 program are summarized below.

Substantial progress has been made toward starting powder improvements and cost reductions. This progress includes advances in precursor materials, precipitation line, calcine furnace, milling and characterization tools. An initial comparison shows reduced cost powders with average J_c values (2700 A/mm² at 4.2K, S.F.) equal to or better than averages in standard powders.

Conductor optimization efforts have yielded substantial results in both J_c/J_E performance and cost reductions. Various starting powders were compared and a clearly superior composition (for dip coated J_c performance) identified. J_c and J_E were studied as a function of 2212 thickness and optimum thickness range identified. J_E values consistently exceed 450 A/mm² (4.2 K, S.F.) in both bare and sheathed tapes. Substantial work has been done to reduce cost through substrate and sheath optimization; this work has resulted in composite substrates with good mechanical properties and minimum silver content. Some issues were encountered with thermal contraction in these composites, which have required additional unplanned effort. New composites have been identified and procured, and results with these new materials are expected this fiscal year. At LANL, microstructural analysis and $I_c(B)$ characterization at 26 K is underway. LANL and OST are collaborating on quantifying I_c distribution across the width of conductors. This characterization data is in use for magnet modeling and design. At NREL, chemical and thermal analyses have contributed to raw materials improvements and cost reductions. NREL and OST are collaborating on alternate processing for improved texture and performance.

Design work has started for the cryogenic systems and magnet.

Research Integration: This SPI team includes three industrial development partners (Oxford Superconducting Technology, SCI Engineered Materials, Oxford Magnet Technology), an industrial end user (Siemens Medical Solutions), and two national laboratories (LANL and NREL). This partnership

vertically integrates a range of expertise and experience including powder synthesis, conductor design and fabrication, magnet and cryogenics design and manufacture, MRI imaging and analysis, and a broad range of analytical and characterization tools at the DOE Labs that complement the project objectives and activities. A monthly teleconference between the partners integrates and coordinates work tasks and facilitates problem solving, which is complemented by weekly e-mails and phone conversations.
