

Cost Effective, Open Geometry HTS MRI System

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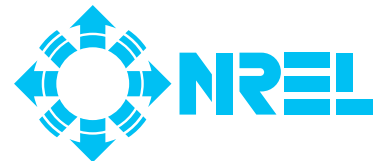


SCI Engineered Materials



SIEMENS

Medical Solutions



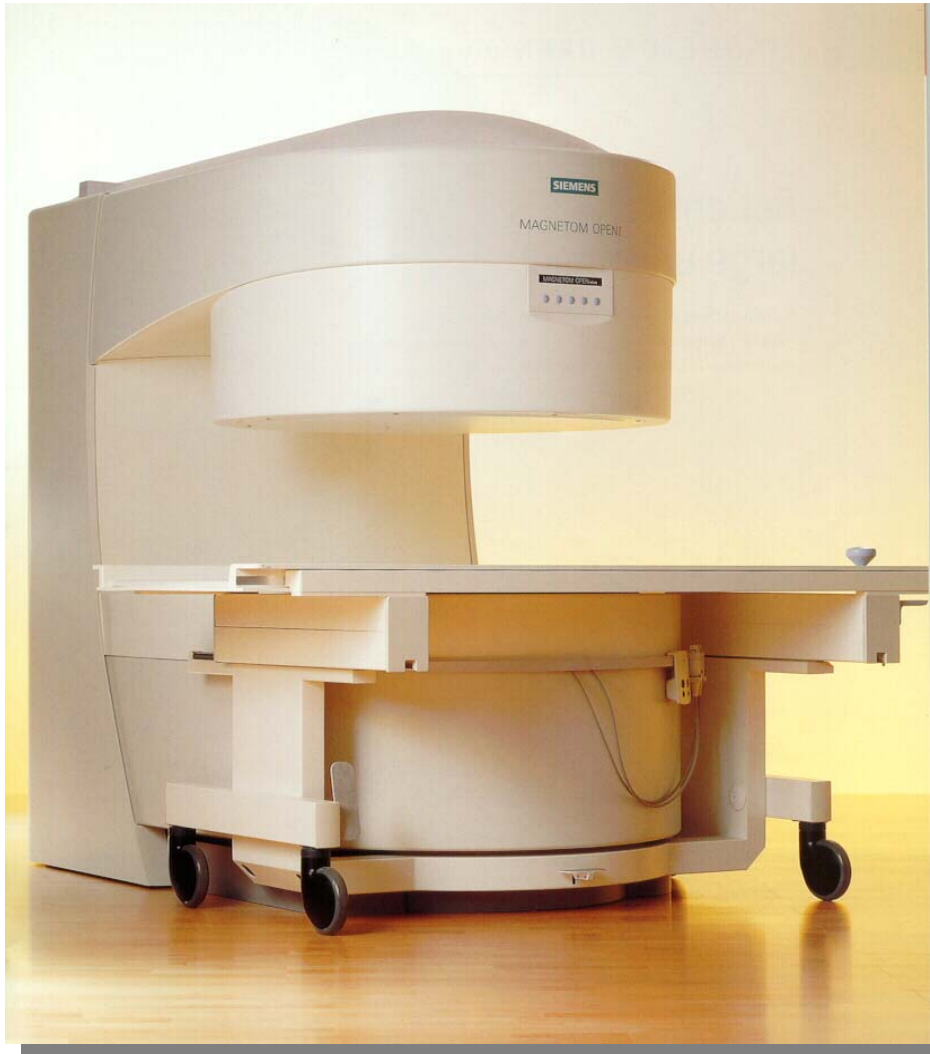
Benefits of MRI

- MRI is the largest existing commercial application of superconductors.
- MRI provides an enormous increase in medical diagnostic ability while simultaneously eliminating the need for harmful X-ray examinations, which has greatly reduced the need for exploratory surgery.
- The availability of very precise diagnostic and location information is contributing to the reduction in the level of intervention that is required, reducing the length of hospital stays and the degree of discomfort suffered by patients.

Potential Benefits of HTS MRI

- The largest obstacle to the wider use of MRI is the capital cost of the equipment.
- Oxford Instruments see a path for dip coated BSCCO-2212 to substantially reduce the capital cost of low field, open geometry magnets.
- By targeting the lower cost end of the market, HTS technology can have a substantial impact on the spread of MRI for use as a routine check in hospitals and even smaller medical laboratories.
- The open geometry is also a fast growing segment of the MRI market.

SIEMENS Magnetom OPEN



- OMT magnet, Siemens imaging system
- 0.2T
- Water-cooled Resistive Aluminium tape coils

HTS Magnet Opportunity

- Existing BSCCO materials have properties well suited for moderate field magnets at temperatures as high as 20-25K.
- We see a path for HTS to lower the cost for low end MRI magnets, leading to more widespread availability.
- MRI provides a commercial opportunity to understand technical and manufacturing issues with HTS tapes.
- OI-Siemens have successfully made an initial demonstration with multifilamentary BSCCO coils.
- This project aims to build on that technical success by demonstrating lower cost coils.

Proposed Device

- Our intention for this project is a magnet running at 0.2 T at 20K on a GM cryocooler, built around existing testbed.
- The ultimate commercial aim is for somewhat higher field, 0.5 T or greater.
- First goal is a BSCCO-2212 dip coated tape magnet. The design and engineering will be such to allow direct substitution of YBCO coated conductor as available.
- Magnet will be integrated into an imaging system and demonstration data acquired.
- Goal is to demonstrate competitive cost and performance in a commercial HTS magnet system.

SPI Team

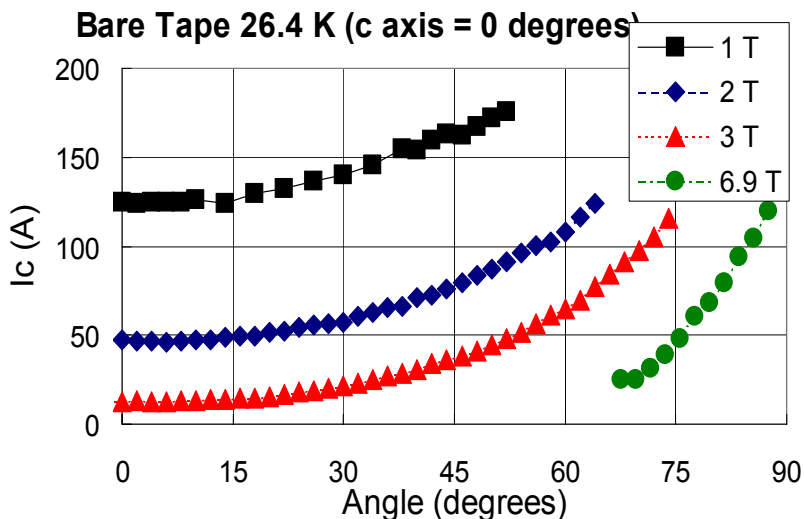
- OST is leading the project and developing the methods of producing commercial dip coated tape.
- SCI Engineered Materials, a leading US supplier of HTS powders, is supporting conductor optimization through powder optimization, scaling, and cost reduction.
- OMT is designing and building the HTS MRI magnet and cryogenics.
- Siemens Medical Solutions will integrate the final system and perform imaging trials.
- LANL is supporting conductor development, persistent joint development, and YBCO impact assessment.
- NREL is supporting conductor development, in particular alternative coating methods for higher performance.

Cost Effective Conductor

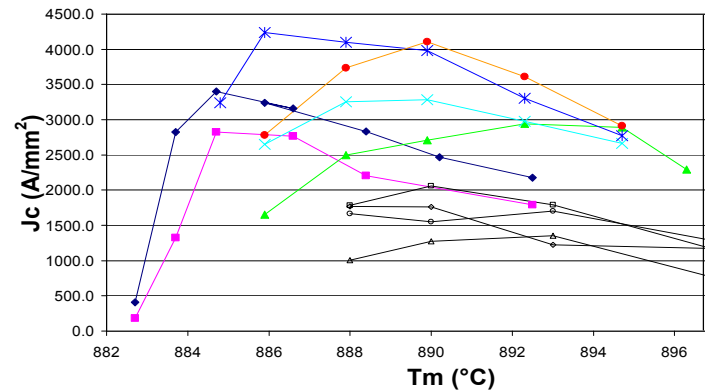
- Note that the overriding issue for this project is really economics: can the system be made at a competitive cost.
- The MRI coil and system technology was previously demonstrated with BSCCO-2223, but conductor costs were much too high.
- So the real target is a *cost effective conductor*.
- The major issue is minimizing conductor \$/kA-m.
- This includes issues of starting materials, fabrication technology, and performance optimization.
- There are additional issues for HTS coil development and optimization, since this conductor configuration is quite different from previously used superconductors.

Conductor Optimization

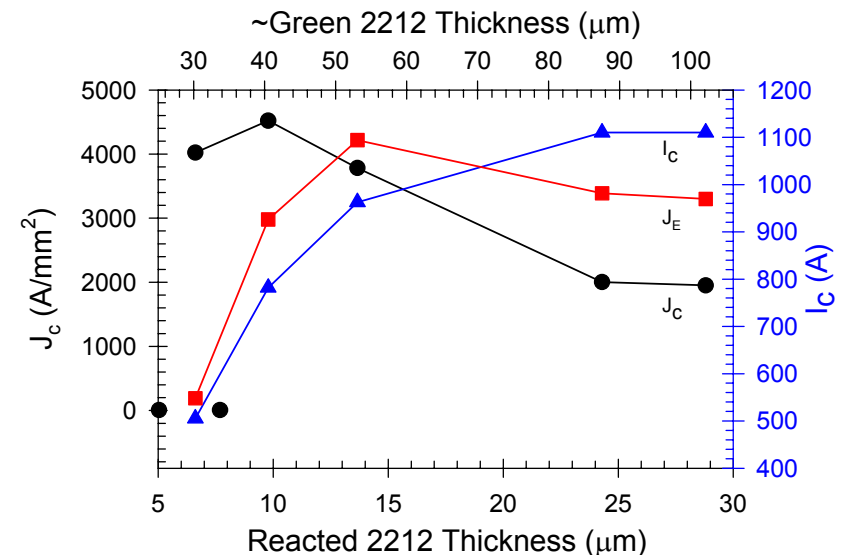
- Powder precursors have been varied and evaluated to reduce costs.
- To achieve minimum cost conductor, optimization studies of both bare and sheathed dip-coated tape are underway.
- Laminated substrates minimize silver content and provide improved mechanical properties and handling.
- Automated powder processing and conductor coating lines are nearing completion.



$J_c(T_m)$ in Different Powder Compositions



J_c, J_E dependence on 2212 thickness



Program Status

- Powder and conductor optimization tasks have provided significant performance and cost improvements.
- Powder synthesis and conductor coating production lines that utilize these improvements are nearing completion.
- A decision on final conductor configuration is expected later this year, based on additional planned performance and cost comparisons.
- Conductor qualification and fabrication is planned for next year, with coil and magnet system fabrication planned for 2005.
- Magnet and cryogenic systems design work is now in preliminary stages using initial conductor performance data.
- Partners at LANL have provided substantial support through SEM, TEM, and $I_c(B,T)$ tests.
- Partners at NREL have provided substantial support through DTA, XRD, and studies of alternate heat treatment and coating methods.

Summary

- The program is well under way, with powder and conductor optimization tasks in process, and cryogenic design recently begun.
- The real challenge for the project is to demonstrate conductor price/performance in the range 5-10 \$/kA-m (at 20 K and 0.5 T).
- We are optimistic this can be achieved.
- The MRI market is expected to be strongly affected once this price target is achieved.
- Other HTS applications may also be enabled by conductor in this price range.