Project Title:	Non-Vacuum Techniques for HTS Coated Conductors
Organization(s):	**National Renewable Energy Laboratory**
Presenters:	Raghu Bhattacharya (NREL)
FY 2004 Funding:	$400 K (NREL)

Project Overview: The U. S. Department of Energy's vision is, "Low-cost, high performance YBCO coated conductors will be available in 2005 in kilometer lengths. For applications in liquid nitrogen, the wire cost will be less than $50/KA-m, while for applications requiring cooling to temperature of 20-60 K the cost will be less than $30/KA-m." One of the important critical needs to achieve this goal is to develop a simple low-cost technology for producing HTS and also buffer layers for low-cost metal substrates. Our project offers non-vacuum electrodeposition, dip coating and spray deposition processing technologies, which are potentially low-cost, long length and continuous processes. At present, we are working on development of HTS and buffer layers employing all these non-vacuum technologies. The YBCO is the primary HTS material system under investigation. The realization of biaxially textured "thick" oxide superconductor films with high transport current is the primary objective for the program. The overall approach for the preparation of non-vacuum HTS tape employs the electrodeposition or spray deposition of buffer layers and superconductor oxide films. Textured substrates, such as NREL's electrodeposited Ni/Ni-W, Ni/Cu, Ni-W/Cu, and other metal and metal oxides, are utilized, combined with appropriate buffer "cap" layers such as CeO_2/YSZ/ CeO_2. NREL is developing electrodeposited biaxially textured buffer layer for YBCO coated conductor in collaboration with other National Laboratories. NREL is developing an electrodeposited Cu stabilizer in collaboration with SuperPower Corporation (industrial partner). NREL is also assisting Oxford Superconducting Technology (industrial CRADA partner) in developing Bi-2212 conductor for a HTS MRI system. The superconducting properties of Bi-2212 was significantly enhanced by NREL developed MgO nano-particle incorporation. NREL provides technical communications support to DOE headquarters staff for the DOE Superconductivity Program for Electric Power Systems. The principal communications support is the maintenance of the DOE Web site for the superconductivity program.

FY 2004 Objectives:

- Investigate non-vacuum techniques for producing biaxial textured buffered metallic substrates.
- Demonstrate $J_c > 10^6$ A/cm^2 at 77 K for YBCO superconducting film using electrodeposited seed buffer layer.
- Explore techniques for improving Bi-2212 by nanoparticle additions.
- Technical communications for the DOE HQ's staff.

FY 2004 Performance and Results:

- Electrodeposited Ni seed buffer layers were developed on textured Ni, Ni-W, and Cu substrates.
- Biaxially textured YBCO was prepared on electrodeposited Ni seed layer with current density of 2 x 10^6 A/cm^2 at 77 K.
- Developed a "melt-quench-melt-growth" (MQMG) process, which facilitated an open reaction and eliminated loss of material during processing.
- MgO nano-particles incorporated Bi-2212 tapes showed more than 60% better superconducting properties at high magnetic field and also a significant improvement (> 33%) was observed at zero field.

- Prepared 70 μm thick Cu layer by electrodeposition process to be used as a stabilizer on YBCO coated conductors.

FY 2005 Plans:

- Prepare electrodeposited biaxially textured buffer layer (innovative and simplified) for YBCO HTS. Electrodeposit non-magnetic Ni-W layer for HTS YBCO.
- Demonstrate $J_c > 10^6$ A/cm^2 at 77 K for YBCO using the NREL developed buffer layer.
- Investigate non-vacuum techniques (specially electrodeposition technique) for producing YBCO superconductor.
- Work with Oxford Superconducting Technology on NREL/OXFORD CRADA. Assist Oxford Superconducting Technology on HTS MRI system.
- Prepare electrodeposited Cu stabilizer on YBCO-coated conductor in collaboration with SuperPower Corporation.
- Technical communications for the DOE Headquarters' staff.

Research Integration: NREL and University of Colorado working together on electrodeposition and spray deposition process. NREL and Oxford Superconducting Technology have CRADA towards the development of HTS MRI system. NREL established new collaborative effort with SuperPower Corporation. NREL is also working with other national laboratories; especially ORNL and LANL, on YBCO coated conductors.