Organizations: **Los Alamos National Laboratory and Oak Ridge National Laboratory**

Project Title: **Accelerated Coated Conductor Initiative: Progress Report**

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FY 2001 Funding: $4,300 K (LANL $2,600 K; ORNL $1,700 K)

Project Purpose and FY 2001 Objectives: The purpose of the Accelerated Coated Conductor Initiative (ACCI) is to accelerate the development, commercialization, and application of high temperature superconductors through joint efforts among DOE laboratories, American industry, and universities, so that future challenges of the electric power industry can be met. Our primary objectives for FY 2001 are:

1. To identify and prepare suitable, high quality, laboratory space for use by DOE laboratories and partners.
2. To develop new equipment needed for more rapid preparation and characterization of coated conductors.

FY 2001 Performance and FY2002 Plans: For FY2001, laboratory space has been identified and prepared to accommodate the facilities at both LANL and ORNL. At LANL, use of a new facility has been arranged. The new Los Alamos Research Park building, finished in the Spring of 2001 and situated outside the lab perimeter, was chosen as the site for the LANL ACCI labs. Part of the first floor (10,000 sq ft) is leased by the LANL Superconductivity Technology Center. It houses four labs dedicated to fabrication and evaluation of coated conductors and three other labs for HTS applications, as well as a suitable number of offices for staff and visiting collaborators. New equipment for research and development of coated conductors is being designed, some of which has already been ordered. The new facility will integrate the successful coated conductor processes developed at LANL with reel-to-reel deposition systems. This will enable research to be conducted in a unified manner and with much higher throughput. At ORNL, renovation of existing laboratory space (~2200 sq. ft.) has been completed. Two adjacent laboratories have been created--one housing conductor preparation facilities and the other housing conductor characterization facilities. Several new and several re-located pieces of equipment have been installed and are functioning in the new laboratory space. Office space for two industrial partners and three post-doctoral associates has been included in the laboratory design.

For FY2002, LANL plans to implement the new high-throughput reel-to-reel systems for a) tape preparation, b) ion-beam assisted deposition (IBAD) of textured buffer layers, c) pulsed laser deposition (PLD) of superconducting layers and d) low-temperature electrical measurements. Additionally, a new high-throughput x-ray diffraction system will be placed in operation that will enable much faster structural determination of coated conductors.

For FY2002, ORNL plans to further develop existing and new equipment for more rapid preparation and characterization of coated conductors. New equipment includes: a) a dedicated rolling mill to accelerate the development of Ni and Ni-based alloy tapes, b) a hybrid effusion

cell/e-beam evaporation system for more stable precursor deposition, and c) high rate, reel-to-reel equipment for evaluating surface optical properties and roughness of tape.

FY 2001 Results: Funding for the ACCI became available to the laboratories in early February 2001. Since that time, laboratory space has been identified and prepared. At LANL, additional lab space is being readied for the new equipment, and new staff members have been hired for the ACCI labs. Equipment for each of the new labs has been designed and is being ordered. An industrial-type tape preparation unit for cleaning, etching, and polishing has been ordered for research on surface finishing requirements needed for IBAD layers. A laser scatterometer will be mounted in-line for real-time surface characterization. A vacuum chamber will be dedicated for IBAD with *in situ* RHEED monitoring and deposition of other buffer layers. Similarly, a PLD chamber for deposition of superconducting and other oxide layers has been designed. An existing high-power (200W) excimer laser will be moved to the new facility for high-rate PLD. Silver coating will be integrated into the PLD chamber. Coated conductor characterization will include x-ray diffraction and I_c measurements. All the new equipment is geared for reel-to-reel handling of coated conductor tape and, therefore, high-throughput experiments.

At ORNL, new equipment added to the dedicated laboratory space includes a reel-to-reel x-ray diffractometer, a reel-to-reel Auger electron spectroscopy module, a reel-to-reel high rate RF sputtering system, a batch reactor for YBCO precursor conversion, and a low-pressure YBCO precursor conversion system. The new reel-to-reel x-ray diffractometer is fully dedicated to the coated conductor program and thus represents a potential doubling of previous x-ray capacity. The reel-to-reel Auger electron spectroscopy module provides *in situ* surface composition characterization of annealed tape. Knowledge of surface composition and structure of the annealed tape is essential for successful growth of epitaxial buffer layers. The reel-to-reel RF sputtering system is used for buffer layer deposition and includes three, 24-in.-long, linear sputter sources. Tape speed for this system is expected to be twenty times that for its predecessor. The batch reactor for YBCO precursor conversion includes a rotating drum on which up to six meters of 1-cm-wide precursor tape can be wound. Batch processing of long lengths of tape can potentially overcome production limitations associated with slow conversion. The low-pressure YBCO precursor conversion system is equipped with energy dispersive x-ray diffraction and mass spectrometry. The potential for higher-rate precursor conversion at reduced pressures can be investigated in this system using real-time measurements of crystalline phase development and gas phase kinetics. To support the ACCI research activities at ORNL, two new staff member and two new post-doctoral fellows have been hired.

Technology Integration: The DOE laboratories, principally LANL and ORNL, have led the early stages of this effort. Identification and preparation of laboratory space have included provisions for extended on-site visitations by industrial and university partners. Ongoing development of equipment and personnel shall be responsive to the needs of CRADA collaborations. Central to this development is the expectation of free exchange of information and materials among the DOE laboratories and CRADA partners.