Project Title:	Ion Texturing Processes for Coated Conductor Buffer Layers
Organization(s):	**Lawrence Berkeley National Laboratory**
Presenters:	R. Reade and P. Berdahl
FY 2003 Funding:	$195 K (tentative)

Project Purpose and FY 2003 Objectives: We are working to fulfill the HTS program need for improved low cost, high-rate, simplified buffer layer templates, utilizing ion texturing methods. These buffer layers are required for future manufacturing of second generation tape conductors. Methods under investigation include ion beam assisted deposition (IBAD) and ion bombardment preferential crystallization of amorphous precursor films (Ion TEXturing, or ITEX).

FY 2003 Performance and FY 2004 Plans: FY03 plans focused on providing broad value in understanding ion beam texturing processes. The scope of the plans was reduced to align effort with available resources. First, we continued our efforts to work collaboratively with LANL to investigate IBAD MgO buffer layer processes and microstructures. The LBNL IBAD effort uses pulsed laser deposition (PLD), which complements the LANL effort using sputtering and e-beam evaporation. We expect these efforts to contribute to the understanding of the IBAD MgO process window in different environments. A full understanding of the process control will be critical to future transfer to manufacturing. Second, we continued studies of ITEX processes during the first half of the year, but this work was largely suspended during the second half of the year in order to focus on the IBAD work. Pole figure investigation of YBCO deposition on the ITEX (211) YSZ textures was performed, as well as atomic force microscopy (AFM) studies of the surfaces to analyze the ion-induced crystallization mechanisms. All work on the ITEX (001) YSZ textures was deferred, as this requires a more long-term fundamental approach.

In FY 2004, we will continue to collaborate closely with LANL on the PLD IBAD MgO studies in order to obtain a complete picture of how this process behaves in the PLD environment. Using the knowledge gained from these studies and the combined ion-texturing expertise of LBNL and LANL, we plan to choose additional material systems for exploratory IBAD processing in order to learn if there are other candidates for rapid coated conductor buffer layer deposition. Characterization will be performed by *in situ* RHEED, x-ray diffraction techniques, AFM, etc. Further analysis of our samples will be performed at LANL. Pending evaluation of resource levels and guidance from program management, we also hope to resume studies of ITEX processing techniques in FY 2004.

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

1. PLD of MgO films was performed, with an initial emphasis on replicating the LANL process conditions. Initial indications with *in situ* RHEED are that at room temperature a non-(001) texture is obtained with PLD, in contrast to previous sputtering and e-beam results. With further exploration of the deposition parameter space we have found that (001) texture can be obtained at different conditions. Studies are continuing to define the process window, and to attempt to understand both the similarities and differences between the results with PLD and the other techniques.
2. Last year, we reported that deposition of YBCO ($YBa_2Cu_3O_7$) on CeO_2-buffered ITEX YSZ (211) surfaces resulted in films with the YBCO c-axis tilted by about 14° from the surface normal. This year, we were successful in depositing YBCO films directly on smooth YSZ (211) surfaces, with the c-axis fully normal. While the ITEX work was put on hold earlier this year (to focus on IBAD), we believe that successful c-axis YBCO deposition demonstrates that the ITEX process is worthy of further research to obtain the improvements in the in-plane alignment of YBCO needed for high-J_c films.
3. Oxygen-deficient amorphous YSZ samples were ITEX processed with varying ion bombardment and temperature schedules that lead to the biaxially-textured YSZ (211) surfaces. Using AFM, we have identified dome-like structures that nucleate under the influence of the ion beam, even at room temperature. These structures resemble the crystallite surfaces of IBAD YSZ films, and we therefore

tentatively identify them as crystalline grains. During further ion bombardment grain coarsening is observed.

Research Integration: LBNL is working closely with LANL to integrate our ion texturing investigations with theirs. LBNL's flexible and versatile ion-assisted PLD system and LANL's well-developed IBAD ion-sputtering and e-beam expertise are highly complementary and together we expect to advance the basic technology research and development of buffer layers for coated conductors. In addition, LANL is providing experimental substrates (including amorphous Y_2O_3 films on silicon to serve as test substrates for IBAD PLD of MgO) and information on the LANL baseline IBAD MgO processes, and LBNL is sending processed samples to LANL for evaluation. LBNL staff visited LANL for joint research discussions and planning, and additional visits at both LBNL and LANL are anticipated.

LBNL continues to pursue areas of common interest with other national labs and industry. For example, we have sent ITEX YSZ samples to ORNL for detailed pole figure analysis and comparison to other types of observed texture obtained by different processing methods.