

**Superconductivity for Electric Systems 2006
Project Summary**

PROJECT TITLE:	Exploring New Directions in the Science and Technology of IBAD Texturing
ORGANIZATION:	Los Alamos National Laboratory
PRESENTER:	Vladimir Matias
FY 2006 FUNDING:	\$ 400K

Project Purpose and FY 2006 Objectives: The IBAD continuous texturing R&D program at Los Alamos is intended to facilitate the development, application and commercialization of high temperature superconductors (HTS). This is done through an internal modest scale up of the IBAD template fabrication processes, development of new materials, processes, and structures for coated conductors and wide-ranging collaborations with US industry, academia, and other national laboratories.

The overall goal in IBAD template research is to achieve a template that is physically robust at high temperatures for epitaxial growth of HTS and a process that is robust for long length manufacturing of the template. We do this by seeking to understand the fundamental issues in the performance of the template and the materials science. In order to do the IBAD research we utilize a linear combinatorial experimental approach, which is enabled by our long-length capability.

Our specific objectives for FY 2006 under the CC development program were:

- To explore the sol-gel process for preparation of IBAD-suitable barrier and nucleation layers
- To increase the speed of the rate limiting step in template fabrication by one order of magnitude

FY 2006 Performance and FY 2007 Plans: The reel-to-reel IBAD system at Los Alamos is routinely producing IBAD textured templates for the needs of our internal efforts as well as for our collaborators. With this system we demonstrated the fastest texture evolution attained, i.e. less than 1 second for texture formation in MgO. This translates to a tape speed of 540 meters per hour in our system, using a 13 cm long deposition zone. This year we have added tilting of the stage so that IBAD or other steps could be done at different angles. We used the tilting to ion etch samples at very shallow angles and reduce the roughness of the surface. We also demonstrated that the epitaxial growth of MgO can be achieved at deposition rates of over 200 Å/sec, while retaining good quality. This is an improvement of 10 compared to our previous rates. The throughput in manufacturing can therefore be increased accordingly.

In this past year we have implemented a reel-to-reel setup for sol-gel deposition of nucleation layers on metal tapes. This process was transferred from Sandia National Lab to LANL, where we implemented a modest scale up that allows us to make meters of substrate. Previously we demonstrated that the sol-gel process can be used as a good nucleation layer for IBAD-MgO. We are still trying to improve the smoothness of the resulting tape in order to be able to start with unpolished metal tapes.

For FY2007, we plan to further improve reproducibility and uniformity of our sol-gel process and to apply it to templates for superconductors. We will evaluate what smoothness of starting material is

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needed in order to have the sol-gel layer be IBAD-ready. We will explore the phase space of IBAD texturing further by examining different materials for texturing. We will examine making IBAD – textured layers on top of YBCO. We also intend to explore an all-conducting buffer layer stack using a conducting IBAD layer.

FY 2006 Results: Highlights of our progress in FY2006:

- Demonstrated high speed of IBAD-MgO texturing with texturing of MgO in less than 1 second; corresponding speed of tape is 540 meters/hr
- Implemented sol-gel process from Sandia in a reel-to-reel transport
- Demonstrated IBAD texturing of TiN, NiO and other rocksalt materials. We have discovered a number of materials which have similar texture evolution in IBAD as MgO.
- Evaluated mechanically polished substrates with an industrial collaborator

Research Integration: On-going development of processes is responsive to the needs of CRADA relationships. We added the CRADA this year with MetOx (Metal Oxide Technologies). In this past year we had the following collaborative highlights:

- CRADA with MetOx was finalized this year. Supplied template tape to MetOx which has enabled them to demonstrate good results on coated conductors
- Supplied template tapes to AMSC, Stanford University, U Wisconsin
- Collaboration with Sandia National Lab and National Renewable Energy Laboratory on barrier layer research for IBAD