Fabrication and Characterization of YBCO Coated Conductors on a Curved Surfaces

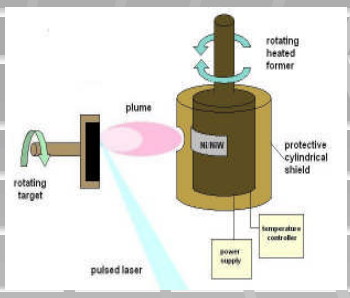
Y.L. Cheung, E. Maher*, J.S. Abell and I.P. Jones
School of Metallurgy and Materials, The University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
*Coated Conductor Consultancy Ltd *(now Coated Conductor Cylinders Ltd., MHSP, Malvern, WR14 3SZ. UK)*

Abstract : Biaxially textured YBCO films and various buffer layers were prepared *in situ* on rotating cylindrical surfaces using highly cube-textured pure Ni and Ni-5at%W RABiTS tapes by pulsed laser deposition (PLD). The superconducting and crystallographic properties of the curved composite were similar to those achieved on flat surfaces. The cube textures of the curved architecture were characterized by electron back-scattered patterns (EBSP). Cross-sectional TEM and Scanning transmission electron microscopy (STEM) were used to determine the chemical analysis, diffusion characteristics, microstructures and interfaces of the curved multilayer samples.

Coated Conductor Cylinder:

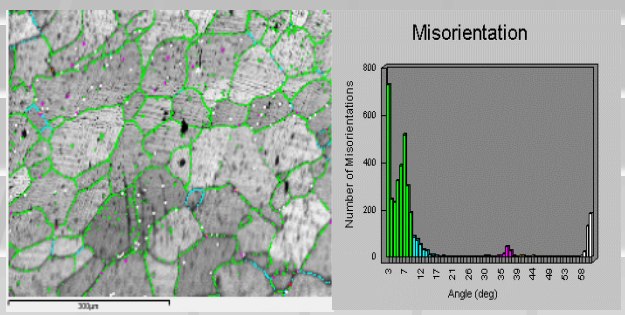
An approach to use a combination of thin film deposition and patterning techniques in order to prepare a multi-turn, multi-layered cylindrical coil (coated conductor cylinder) without the requirement of producing long lengths of coated conductor tape. If this novel technology is successful, only one layer of base substrate would be required to provide the initial texture, thus the cost will be dramatically reduced and J_E will be significantly increased by proportionately increasing the YBCO cross-sectional area. Moreover, producing a coil is simply by a multi-layer *in situ* deposition sequence onto a rotating cylindrical former . It will overcome the requirements of reproducible manufacture of kilometre lengths within a vacuum chamber.

Laser and deposition chamber at the University of Birmingham.

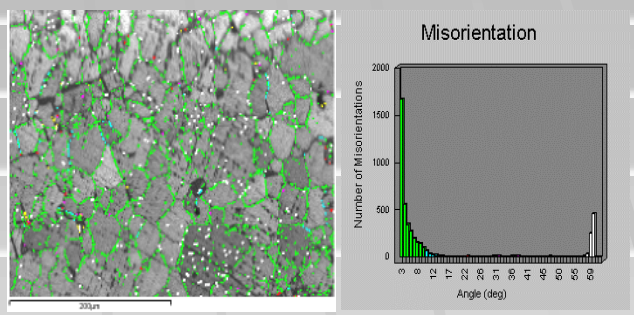


Schematic diagram of the rotating cylindrical heated former in the chamber.

A. EBSD Data



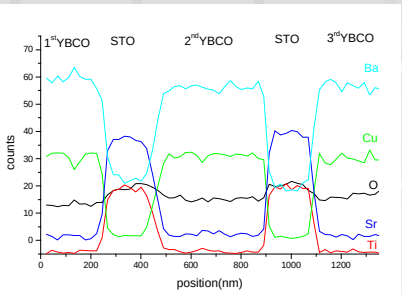
Grain boundary data measured by EBSD from the final CeO2 layer deposited on curved buffered Ni. (Left) Grain boundary positions superimposed on the pattern quality image (Right) The boundaries are colour coded according to the histogram of misorientation angle.



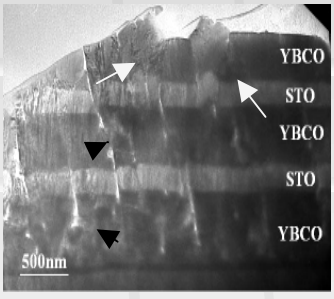
Grain boundary data measured by EBSD from the final CeO2 layer deposited on curved buffered Ni-5%W. (a) Grain boundary positions superimposed on the pattern quality image. (b) The boundaries are colour-coded according to the histogram of misorientation angle.

B. STEM

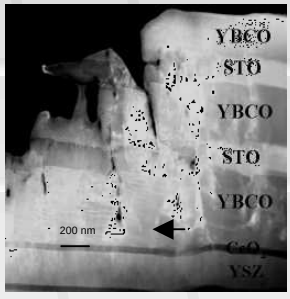
Transmission Electron Microscope, Tecnai F20, FEI.



STEM quantmap linescan from first YBCO layer to third YBCO layer. The elements showed even counts in each layer and the interfaces between the layers were sharp and clean. It proves that there was no significant diffusion between the YBCO layers and STO insulating layers. SrTiO3 is a good diffusion barrier and insulating layer in this research.



Cross-sectional transmission electron micrograph of triple YBCO layers on curved buffered Ni tapes. Outgrowths are indicated by white arrows and pores are indicated by black arrows.



Dark field STEM image of triple YBCO layers on curved buffered Ni tapes. Black arrow indicates the porosity in the first YBCO layer.

Conclusion:

Sharp and cube EBSD patterns of CeO2/YSZ/CeO2 on curved Ni and NiW were successfully acquired. The grains on pure Ni tapes had large misorientation; however, the misorientation of the grains on NiW tapes were mostly between 2-10 degree which provides a good template for growing YBCO layers.

Outgrowths and pores were observed in the YBCO layers. TEM micrographs showed that the occurrence of pores and surface roughness were dependent on YBCO thickness. STEM quantmap linescan showed that there was no significant diffusion between the YBCO layers and STO insulating layers. STO is a good diffusion barrier and insulating layer for separating YBCO layers in this research.

Poster presented at ASC2004, Jacksonville, Florida, October 2004.