Progress Towards Coated Conductor Cylinders: ISD Texture Formation and $YBa_2Cu_3O_7$ growth

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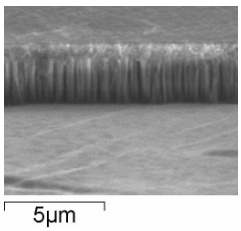
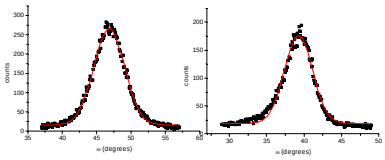




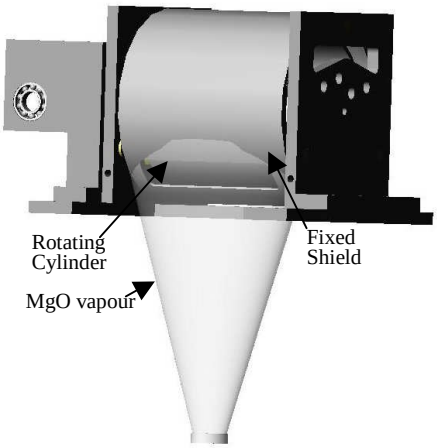
MgO (400) rocking curve **FWHM = 4.5˚**

MgO (311) rocking curve **FWHM = 3.8˚**

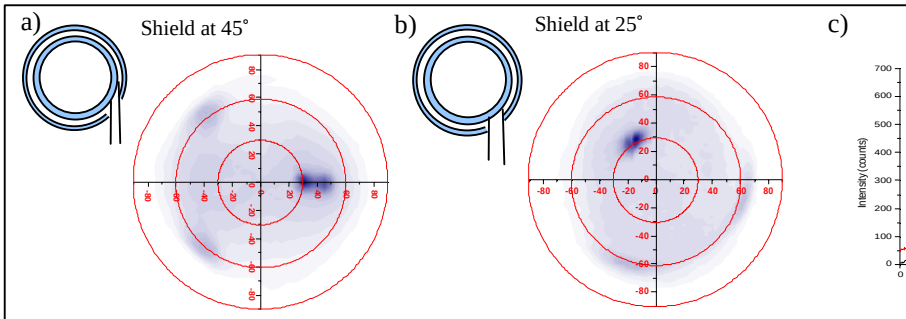
The Inclined Substrate Deposition (ISD) technique has been successfully used for inducing a cube texture onto polycrystalline substrates as the basis for subsequent HTS epitaxy for coated conductor tapes. Here we describe the adaptation of this technique to the case of cylindrical formers used in the coated conductor cylinder concept.

The technique involves the deposition of MgO by electron beam evaporation onto the substrate at a defined angle, producing a columnar morphology with a cube texture. This friable structure is stabilised and smoothed by the deposition of a homoepitaxial MgO layer at elevated temperatures and at normal incidence. The electron micrograph to the left shows a typical cross sectional image. The resultant texture on planar substrates is essentially cube textured with excellent rocking curve widths (see left).

We are using the setup in the schematic (on the right) to produce a similar texture on stainless steel cylindrical shell formers. We also present some results on HTS deposition onto these substrates.



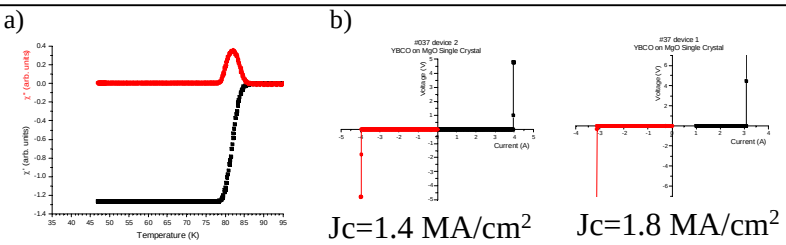
ISD texture formation on Cylindrical Formers



(a) MgO (002) pole figure of a cylinder with the shield arranged at 45˚ to the flux direction. A wide range of angles of the MgO flux is presented to the cylinder. This results in a broadening of the (200) peaks in the circumferential direction. Also the (200) direction is rotated at 45˚ with respect to the circumferential direction - not necessarily the ideal orientation for optimal current carrying in an epitaxed YBCO layer
b) MgO (002) pole figure of a cylinder with the shield arranged at 25˚ to the flux direction. The MgO peaks are less broad and the texture is now oriented with the (100) directions parallel and perpendicular to the circumferential direction.
c) (002) rocking curves taken in the circumferential direction of the 25˚ deposited cylinder. Two positions are measured, the centre and edge of the cylinder. The rocking curves are very similar, showing a FWHM of 10-12 degrees.

$YBa_2Cu_3O_7$ growth by PLD on MgO Single Crystal

In order to qualify the Pulsed laser deposition $YBa_2Cu_3O_7$ growth process, single crystal MgO substrates were used.
a) shows a typical AC susceptibility result, with a Tc onset at 86K and a width of around 4K.
b) Current-voltage curves measured at 77K on photolithographically patterned and wet etched tracks. The track dimensions are 800 microns by 2 mm long. The two tracks are perpendicular to each other, an arrangement which will allow the examination of the anisotropy in the ISD textured material.



$Jc=1.4$ MA/cm^2 $Jc=1.8$ MA/cm^2

$YBa_2Cu_3O_7$ growth by PLD on Planar ISD textured Stainless Steel

Initial results on the $YBa_2Cu_3O_7$ growth on planar ISD textured 310 stainless steel.
a) AC susceptibility of a typical 500nm thick film deposited onto an ISD layer. The Tc onset is reasonable but the transition width is broad.
b) MgO (002) and $YBa_2Cu_3O_7$ (006) x-ray pole figures of YBCO on ISD on stainless steel. This shows clear epitaxy of the YBaCuO onto the ISD MgO

As yet, the Jc results for these layers at 77K are rather poor (~10,000 Acm^{-2}).