Preliminary study on texture characterization of the $Ce_{0.9}La_{0.1}O_2$ /$Gd_2Zr_2O_7$ buffer layer stack on NiW alloy substrates by synchrotron radiation

Y. Zhao, A.B. Abrahamsen, J.-C. Grivel, J. Bednarčík[1], and M. von Zimmermann[1]

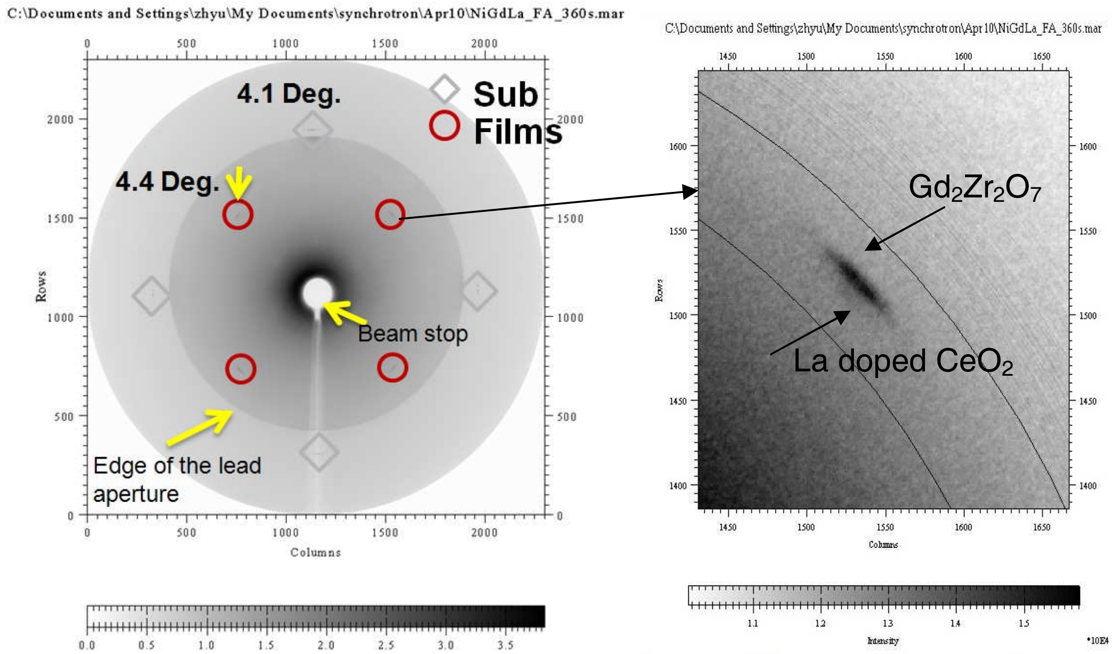
Risø DTU, Technical University of Denmark, Frederiksborgvej 399, 4000 Roskilde, Denmark
[1]HASYLAB at DESY, Notkestrasse 85, 22603 Hamburg, Germany

Owing of the weak-link behaviour of the $Y_1Ba_2Cu_3O_{7-x}$ (YBCO), high temperature superconductor, the achievement of high critical current in long conductors requires a so-called "coated conductor" architecture based on the sequential epitaxial growth of oxide layers on textured substrates[1, 2, 3]. From the practical application point of view, producing biaxially textured flexible templates is one of the key issues in the development of long length coated conductor tapes. In our previous work, an optimized buffer layer architecture, $Ce_{0.9}La_{0.1}O_2/Gd_2Zr_2O_7$, for rolling-assisted biaxially textured substrate route was proposed and developed by the metal organic deposition method, where a $Ce_{0.9}La_{0.1}O_2$ layer with prefect lattice match with the YBCO layer is chosen as cap layer, while a $Gd_2Zr_2O_7$ film acts as barrier layer. However, there are still several crucial problems that need to be solved, such as the deterioration of the texture quality from the underlying layer to the top layer, and the nucleation and growth processes of the oxide film on the metallic substrate.

In the view of future *in-situ* phase and texture evolution studies, the characterization of double side $Ce_{0.9}La_{0.1}O_2$ (top layer)/$Gd_2Zr_2O_7$ (barrier layer) prepared by chemical solution method via dip coating technique on biaxial textured Ni-5at.%W alloy substrate was carried out at room temperature on fully processed samples as the first study. The experiment was performed at the beamline BW5 with a 80keV incident beam. The sample rolling plane (surface) was perpendicular to the beam, allowing the observation of the in-plane reflections of both the buffer layer and of the metallic substrate. A lead pin-hole screen was also employed to weaken the strong diffraction from the substrate. Considered the poor Signal/Noise ratio for the thin buffer layers on the thick metal substrate, the sample was kept static during the exposure, preventing a too high background intensity resulting from the rotation.

The visible diffraction spots of both the substrate and the thin films are exhibited in Figure 1, revealing the 45^o rotation epitaxial growth relationship between them. To quantify the in plane texture of the substrate and the films, the full width at half maximum of 4.1^o and 4.4^o respectively, was calculated by Gaussian fitting. The deterioration of in plane texture from the substrate to films is only 0.3^o as determined by this study, which is smaller compared to that derived from the phi scan by standard CuKα based XRD (as large as 1^o). One essential reason is that, the "real" in plane crystallographic alignment can be characterized by synchrotron diffraction measurement. For example, the in plane texture of the substrate is evaluated using the (200) reflection of nickel in this study, instead of using its (111) reflection in standard XRD phi scan.

This result shows that it is possible to investigate the epitaxial growth relationship among all sequentially deposited films and the substrate in coated conductors. Moreover, the phase and texture formation processes of oxide film, in principle, can be described by investigated by means of *in-situ* synchrotron measurement by optimizing the combination of the substrate and film thickness.



a) b)

Figure 1: Diffraction pattern of the $Ce_{0.9}La_{0.1}O_2$ /$Gd_2Zr_2O_7$/Ni-5at.W/ $Gd_2Zr_2O_7$/ $Ce_{0.9}La_{0.1}O_2$ sample, a) overview, b) the enlarged image of the diffraction spot from the thin films.

References

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