Buffer layers and YBCO growth on Ni RABiT tapes.

Donet[1] Sébastien., Weiss[1] François., Chaudouet[1] Patrick., Selbmann[2] Dietmar., Prusseit[3] W., Bruzek[4] Christian-Eric, Saugrain[5] Jean-Maxime. Laboratoire des [1] :Matériaux et du Génie Physique, UMR CNRS 5628, ENSPG BP 46, 38402 St Martin d'Hères, France. [2]:IFW, Dresden, Germany. [3]: THEVA, D85386 Eching, Germany. [4]: NEXANS, Jeumont. [5]: NEXANS,Clichy.

High Temperature Superconducting YBCO-coated conductors development remains one of the most thrilling challenge for future energy saving. High density (Jc=1MA/cm^2) films were recently demonstrated on Biaxially Textured Substrates (RABiTS), which transfer it texture to the YBCO film. In order to obtain high quality YBCO film (in-plane orientation of the film less than 10°) on a flexible support, buffer layers between the metallic tape and the YBCO film, typically 400nm has been required to adapt the mechanical stress and to avoid chemical interaction or diffusion inter-layers. In this paper are presented results obtained by Pulsed Injection Metal Organic Chemical Vapour Deposition (PI-MOCVD) technique on various Ni RABiT tapes. In a first step, we focused in developing suitable architecture mainly on Ni/CeO_2 biaxial textured substrates. MOCVD of thin YSZ (200nm) with subsequent CeO_2 (150nm) layer has been necessary to obtain high critical current density. The precursors used for the buffer layers and YBCO deposition are organometallic ones: $Zr(thd)_4$, $Ce(thd)_2$ $Y(thd)_3$, $Ba(thd)_2$, and $Cu(thd)_2$ dissolved in 1,2-dimethoxyethan.

First, Ni pre-buffered tapes were coated with YBCO in a reel-to-reel system at transport velocity of 3m/h. Small (10x10mm) and longer tapes (10x40mm) were covered with 700nm YBCO thin film. SEM picture shows dense film with some CuO on surface (see Fig.3). The critical current densities measured by AC susceptibility were from 0.3 to 0.5MA/cm^2 at 77K correlated with a strong epitaxial growth as reported on Fig 2.

Secondly, Theva Gmbh supplied Ni/CeO_2 tapes with 100nm CeO_2 deposited by Thermal Evaporation, stabilising the surface for MOCVD process. Indeed the pure microalloy Ni tape obtained by a Rolling Assisted Biaxial Textured Substrate (RABiTS) process remain sensible to MOCVD operational deposition conditions (800°C with oxygen atmosphere). A complete characterisation of the Ni/CeO_2 tape gave us an overview of the defects of the tape. The texture of the Ni/CeO_2 reveals a pure cubic (ccf) structure (pole figure by XRD) with rare disoriented grains (Fig.1): less than 3% NiO(111) grains have been detected in EBSD analysis. In order to obtain high quality YBCO films on Ni/CeO_2 substrates, we piled up buffer layers to avoid Ni interaction (detected in EDS and EBSD technique) with YBCO films altering the superconducting properties. After optimisation of the deposition conditions and the nature-thickness of the adequate layers we finally obtained YBCO films with good superconducting properties (Jc= 0.6MA/cm^2 by AC susceptibility measurement). The optimised heterostructure consists in Ni/CeO_2//**YSZ/CeO_2/YBCO** with respectively 200nm of YSZ, 150nm CeO_2 and 750nm of YBCO.

Longer coated tape, i.e. 20cm long has also been covered in the tape reactor. Weak variation of the texture was detected all along the tape

On the other hand superconducting films were deposited on Ni/NiO microalloyed tapes. On NiMo tapes, NiO(111) growth as well as small MoO_3 crystals used to form in the holes of NiO leading to disoriented domains. These inhomogeneous zones damage the surface morphology of the NiO film inducing defects amplified by addition of YSZ, Y_2O_3 or CeO_2 films. The approach has been to regrow on NiO layer a thin film of NiO by MOCVD, with a selective growth followed by quasi-homoepitaxial growth of NiO on NiO. Improvement of the NiO texture was measured in XRD experiments and showed in-plane texture improvement of 2°. A smoothing effect depicted on SEM and AFM pictures shows the effect of a 350nm thin film of NiO by MOCVD. The grooves visible before were quite weaken The adequate buffer layer stacking NiW/NiO//**YSZ/Y_2O_3/YBCO** previously discovered concist in depositing 200nm of YSZ, 150nm Y_2O_3 and 750nm YBCO to obtain critical current densities Jc= 0.1MA/cm^2 on NiMo tapes.

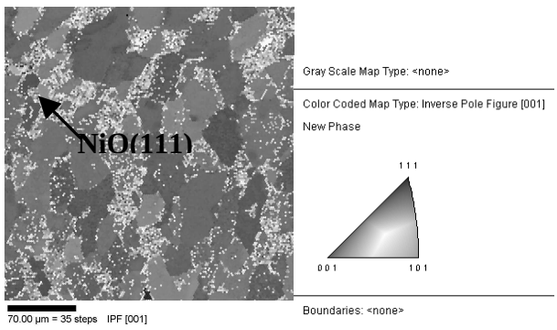

Fig. 1.EBSD data of the Ni/CeO_2 tape 50µm thick. Inverse pole figure (001).

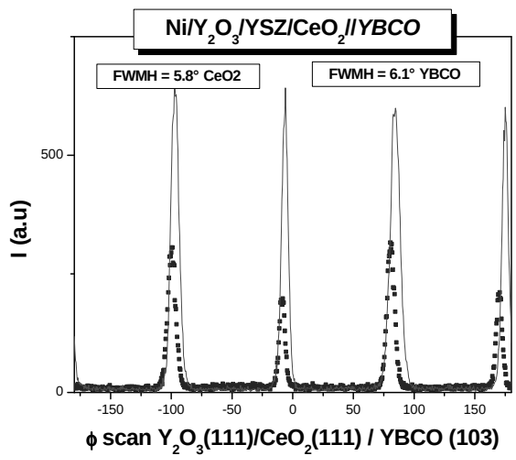

Fig. 2. XRD diagram of the in-plane texture of the films

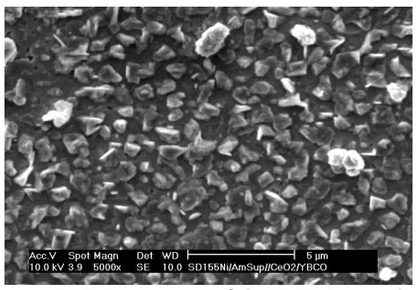

Fig. 3. SEM picture of the YBCO morphology on Ni pre-buffered tape.

The European Community as part of the Brite Euram READY project, BE97-4572, financially supported this work.