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Oak Ridge National Laboratory, TN 37831, USA

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Ni substrates with a standard architecture of $YBCO/CeO_2/YSZ/CeO_2/Ni$.[3,4] The starting CeO_2 was mostly obtained by either e-beam or pulsed laser deposition (PLD). Formation of cracks in CeO_2 films of dver 200 nm thick on Ni substrates has prevented us from utilizing CeO_2 as a single buffer layer so far.[2,5] Also, CeO_2 films go through a reduction to Ce_2O_3

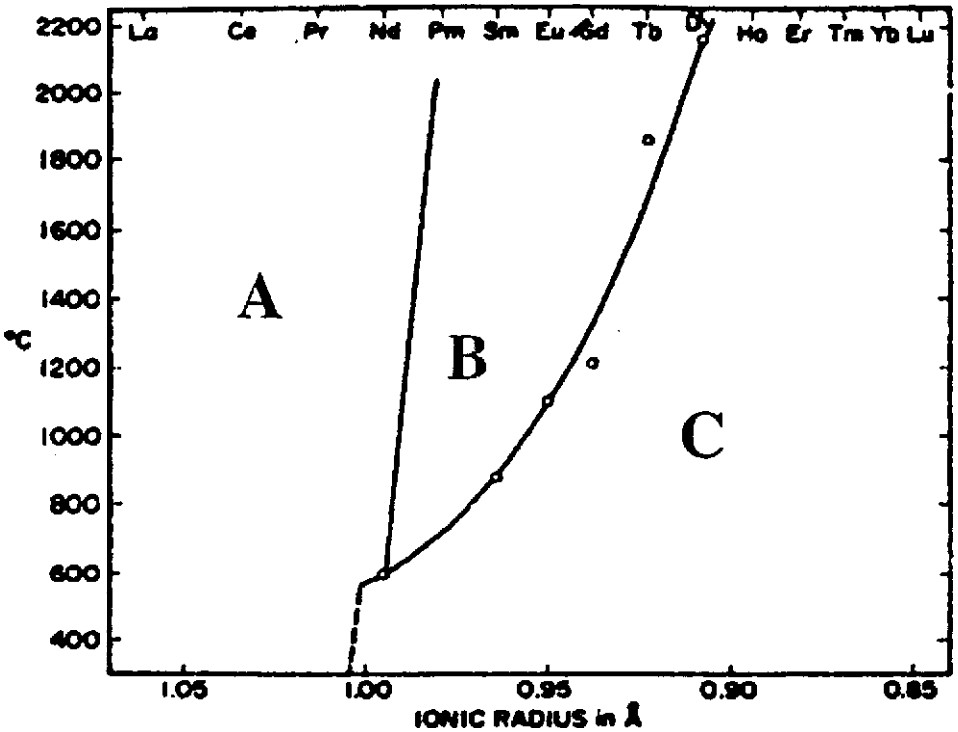


Figure 1. Structural stability relationships for RE_2O_3 (adapted from reference 8). The symbol A represents the hexagonal structure, B represents the monoclinic structure. and C represents the cubic structure.

0.25–0.5 M rare earth methoxyethoxide in 2-methoxyethanol. The coating was done either by spin coating at 2000 rpm for 45 sec or by linear dip-coating in which the Ni strip was immersed in the precursor solution and then withdrawn at a rate of 3 cm/min. After coating, the Ni substrates were annealed in a mixture of 4% H_2 and 96% Ar (Forming gas) at temperatures ranging from 1050-I 150 °C for 1 h and quenched to room temperature.

The rf magnetron sputtering technique was used to grow Yb_2O_3 on e-beam grown Y_2O_3-buffered Ni substrates at 780 °C.[7] Similarly YSZ and CeO_2 cap layers were grown on RE_2O_3-buffered Ni substrates at 780 °C using rf magnetron sputtering. The plasma power was 7.5 W at 13.56 MHz. The resulting Yb_2O_3, YSZ, and CeO_2 films were smooth and dense. Pulsed laser deposition was used to grow YBCO at 780 °C and 200 mTorr O_2 on sputtered Yb_2O_3 layers. Precursor YBCO films were grown on CeO_2-buffered

RESULTS AND DISCUSSION

Using reactive evaporation, high quality Y_2O_3, Gd_2O_3, and Yb_2O_3 films were grown with a single cube texture directly on {100}<001> textured-Ni substrates.[6] Similarly, using a non-vacuum process, high quality Gd_2O_3, Yb_2O_3, and Eu_2O_3 films were grown with a single cube texture directly on (100}<001> textured-Ni substrates.‘,’[10] Detailed microstructure studies indicate that these RE_2O_3 buffers were dense, continuous and crack-free. A superconducting YBCO film 300 nm thick deposited onto the Yb_2O_3 [illegible][6,7] in Figure 7. The microstructure of the YBCO film looks porous but with plate-like morphology similar to those observed previously for epitaxial Tl-1223 films.

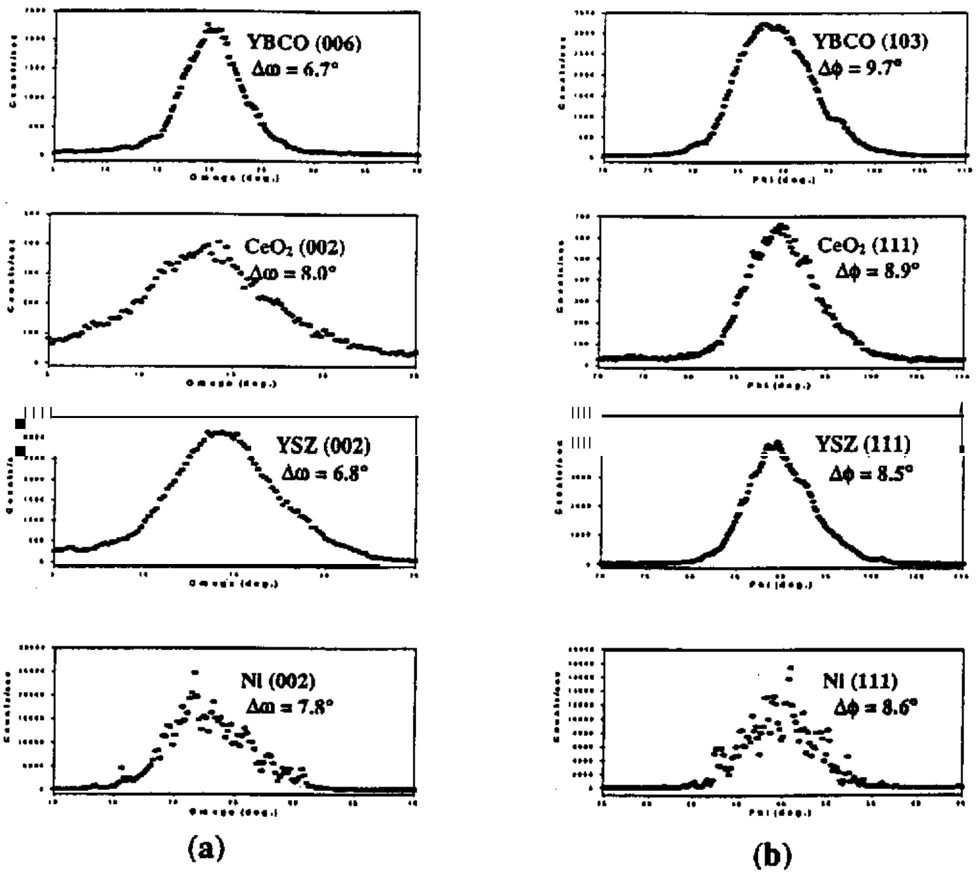


Figure 2. The ω and φ scans for a 300 nm thick YBCO film on CeO_2 (sputtered)/YSZ (sputtered)/Yb_2O_3 (e-beam)/Ni substrates.

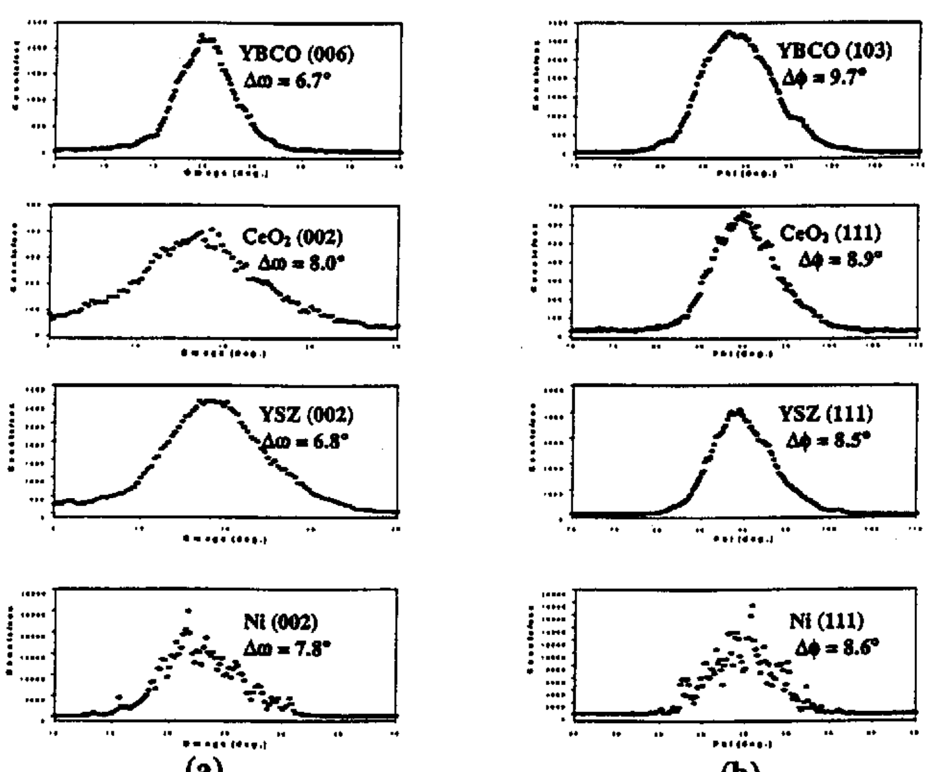
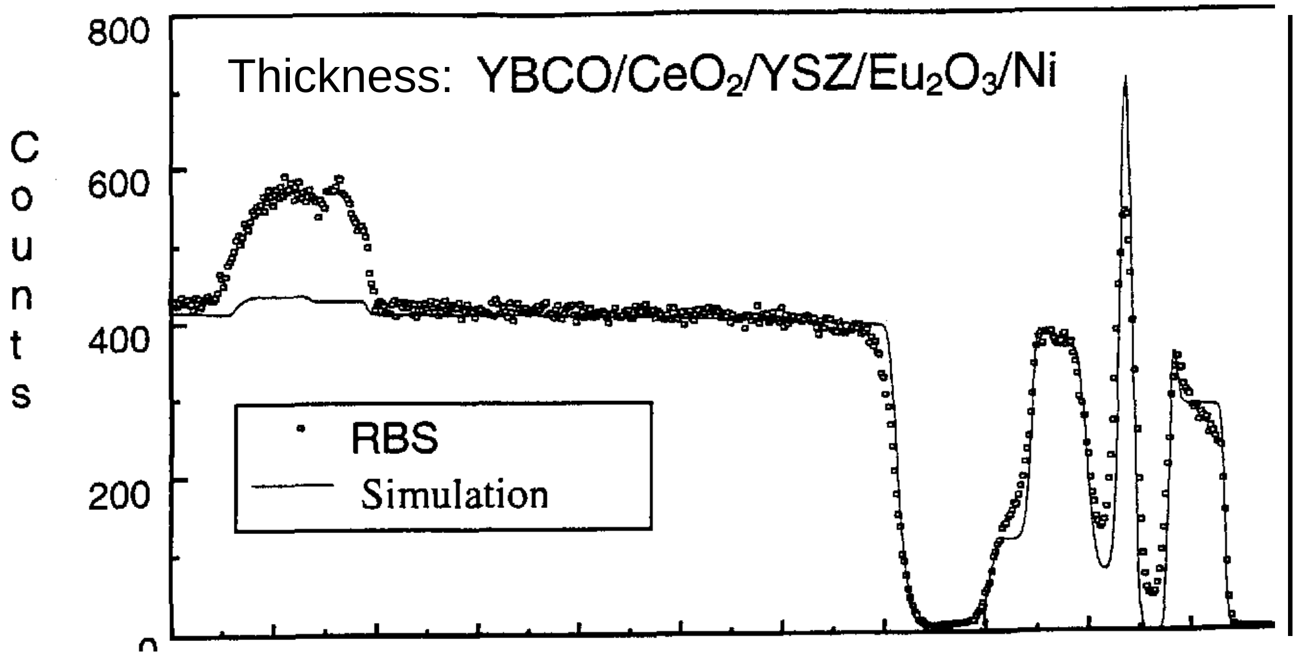
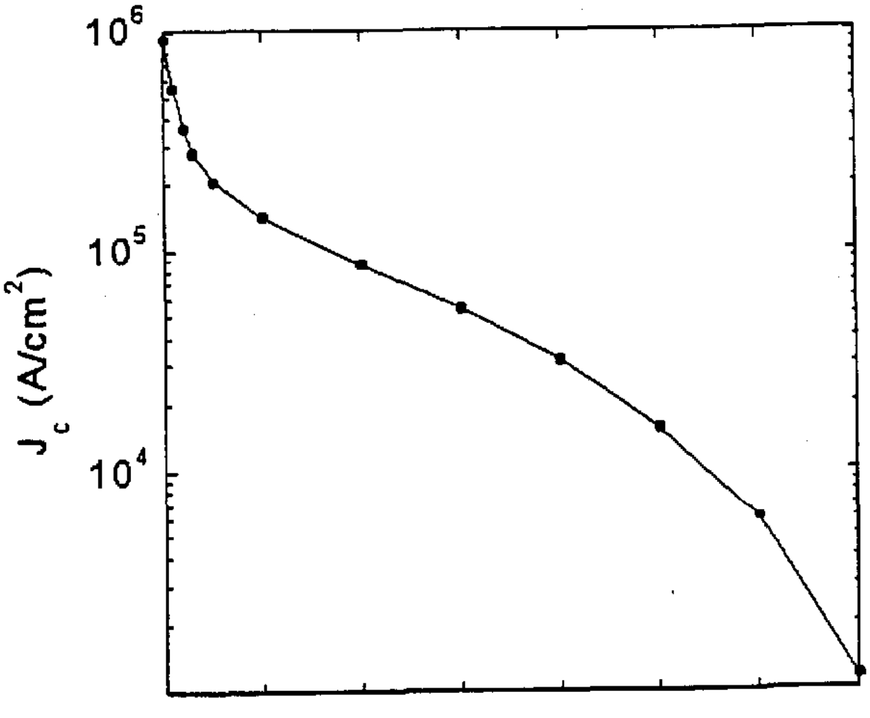


Figure 3. The to and φ scans for a 300 nm thick YBCO film OR CeO_2 (sputtered)/YSZ (sputtered)/Eu_2O_3 (dip-coated)/Ni substrates.



Thickness: YBCO/CeO2/YSZ/Eu2O3/Ni
Counts
800
600
400
200
0
RBS
Simulation



J
c
(A/cm
2
)
10
6
10
5
10
4

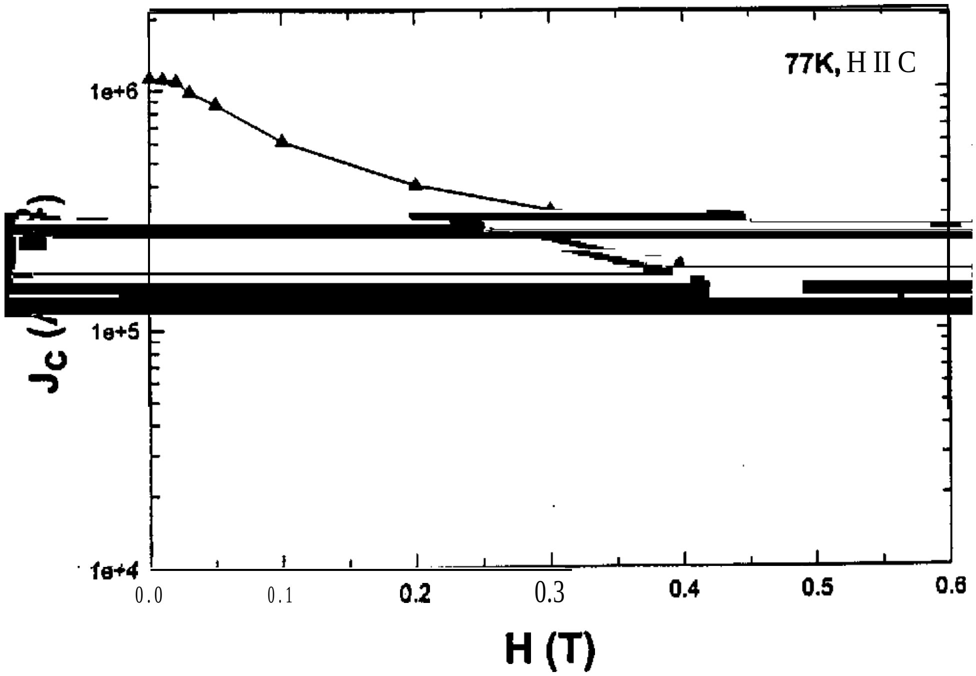


Figure 6. The field dependence of critical current density, J_c for 300 nm thick YBCO film On CeO_2 (sputtered)/YSZ(sputtered)/Eu_2O_3(dip-coated)/Ni substrates.

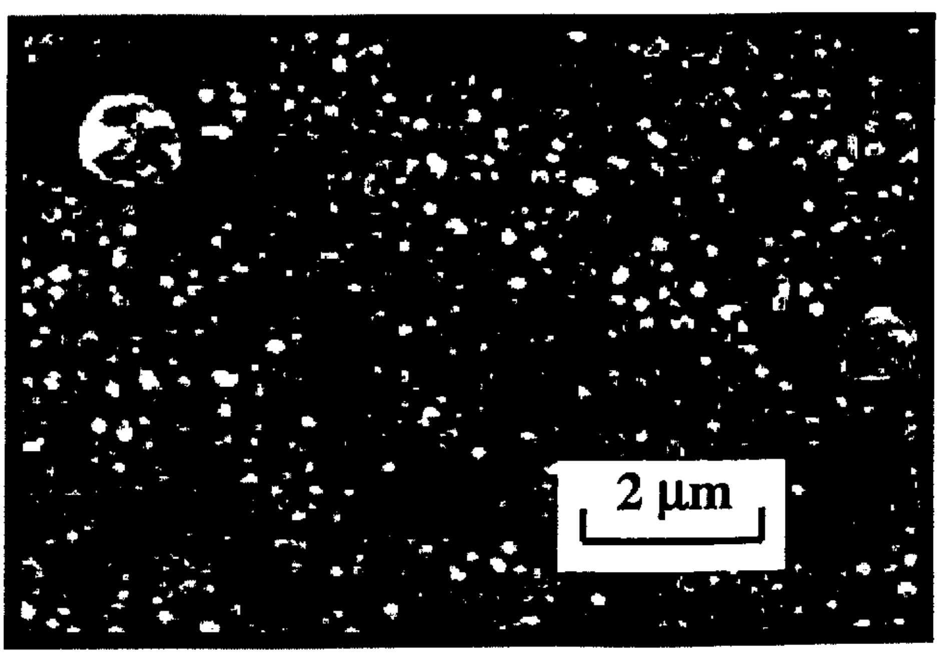


Figure 7. SEM micrograph for 300 nm thick YBCO film on CeO_2 (sputtered)/YSZ (sputtered)/Eu_2O_3 (dip-coated)/Ni substrates.

CONCLUSIONS

We have demonstrated that several high quality RE_2O_3 films can be grown epitaxially with a single cube-on-cube orientation on {100}<001> textured Ni substrates using both reactive evaporation and sol-gel processing. The microstructures of RE_2O_3 buffers grown by both techniques were dense, continuous and crack-free. The performance of sol-gel grown buffers approached the quality of e-beam grown buffers. High J_c YBCO films were grown on RE_2O_3 templates with two new buffer layer architectures. A high J_c of 1.8 MA/cm^2 at 77 K and self-field was obtained on this $YBCO/Yb_2O_3/Y_2O_3/Ni$ architecture. Also, a high J_c of over 1 MA/cm^2 at 77 K and self-field was obtained on this $YBCO/CeO_2/YSZ/RE_2O_3/Ni$ architecture.

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