

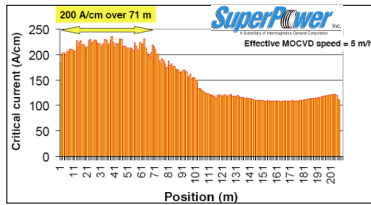
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Motivation

SuperPower has made significant progress in the development of high performance YBCO coated conductors using Ion Beam Assisted Deposition (IBAD) templates and Metal-Organic Chemical Vapor Deposition (MOCVD).

Addressing non-uniformity over very long lengths (> 100 m) is a high priority to improve overall performance.



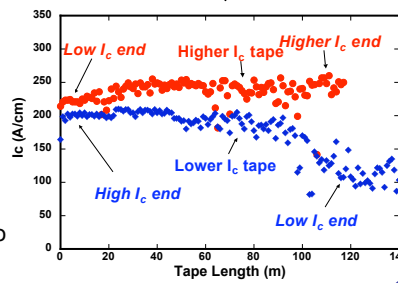
In this work, we established the causes for variations in performance from:

- tape-to-tape and
- end-to-end

Experiment

In order to identify the causes for non-uniform performance, we studied segments from two long-length tapes that exhibited differences in performance between each other and from end-to-end within each tape.

We used FIB-assisted SEM, TEM, Raman, and magneto-optical imaging to establish the basis for performance variations and to link that behavior to processing.

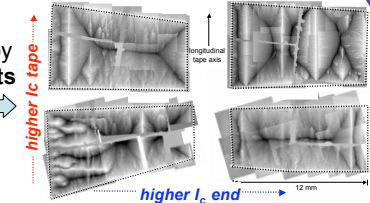


Global structure & the performance "ceiling"

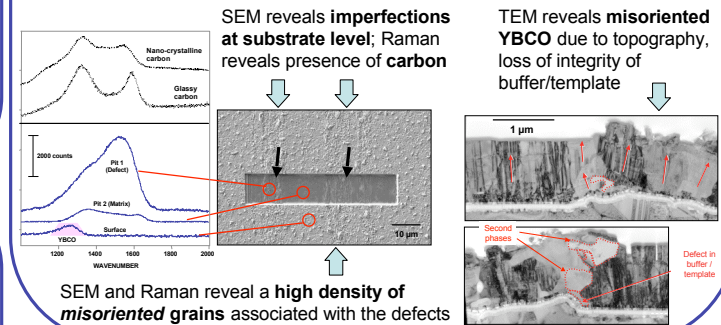
Longitudinal defects revealed by MOI arise from substrate defects

Not likely cause of performance variations:

- parallel to current flow
- ≈ same for all segments



- possible limit to overall performance



Microstructural basis for performance variations

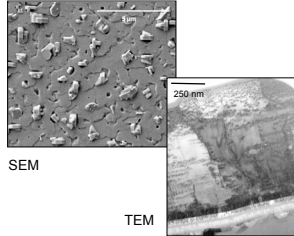
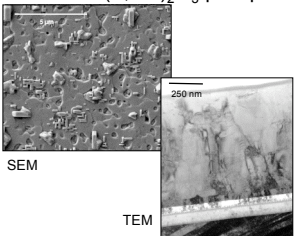
Global changes in microstructure from tape-to-tape:

High Ic tape

- well-connected grains
- surface a-axis grains
- substrate reaction
- coherent (Y,Sm)₂O₃ precipitates

Low Ic tape

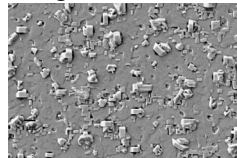
- tilted grains, visible boundaries
- few surface a-axis grains
- no substrate reaction



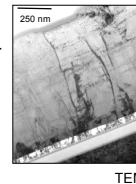
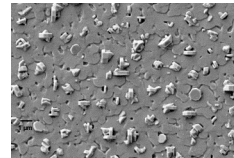
Tape-to-tape differences concluded to be due to deposition temperature based on microstructure

Similar signatures in in microstructure from end-to-end:

High Ic end



Low Ic end



High Ic end: well-connected grains, surface a-axis grains, coherent (Y,Sm)₂O₃ precipitates

Low Ic end: tilted grains, visible boundaries, no precipitates

End-to-end variations also due to temperature

Conclusions

- Our coordinated characterization provides a correlation between processing and behavior in SuperPower's conductors:
- microstructural evidence that differences in performance from tape-to-tape and from end-to-end are due to differences in temperature
- global defect structure revealed by MOI may limit highest performance; our characterization reveals that this defect structure originates from imperfections at the substrate
 - surface topography; degraded integrity of buffer, template layers; influence of carbon