

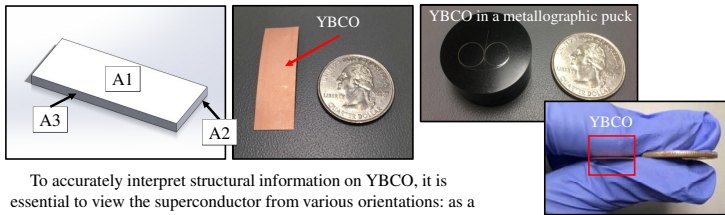
Introduction

- ❖ $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO) is a high-temperature, high-field superconductor with promise for usage in high-field magnets. The superconductor lies within a composite tape that provides mechanical strength and allows for the correct crystal growth direction of the superconductor.
- ❖ High amounts of internal stress can cause these layers to delaminate, hindering the electrical properties of the tape.
- ❖ The aim of this research is to understand how various sample preparation techniques (including slitting and metallographic polishing) impact the delamination tendencies of YBCO. Focus has also been centered on sample preparation for microscopy and other analyses.

Acknowledgements

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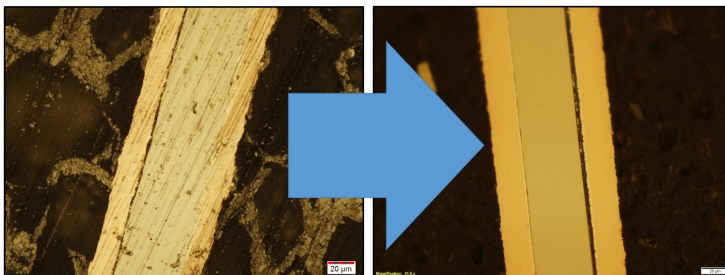
Sample Preparation Methods



To accurately interpret structural information on YBCO, it is essential to view the superconductor from various orientations: as a flat surface (A1), as a transverse cross-section (A2) and as a longitudinal cross-section (A3).

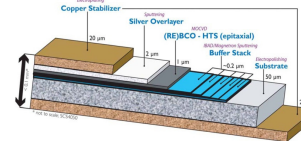
- ❑ To view and analyze YBCO at orientations A2 and A3, a mounting and polishing procedure is performed
- ❑ A specimen of YBCO is placed in a hot mounting press and surrounded with a conductive powder that allows for later microscopy
- ❑ The conductive filler melts and surrounds the sample, pressure is applied and then the enclosed sample undergoes a cooling phase
- ❑ The sample is now encased in a metallographic puck, which undergoes a polishing procedure
 - ❑ Polishing creates a perfectly smooth sample surface, which improves microscopy analysis

Stage	Pad	Suspension	Platen Speed	Time	Comments
1	600 grit	Water	200rpm	5 minutes	Hand Polished
2	800 grit	Water	200rpm	5 minutes	Hand Polished
3	Nylon	1 um Diamond Suspension	50rpm	5 minutes	Automated polishing
4	Nylon	6um Diamond Suspension	50rpm	5 minutes	Automated polishing
5	Final A	0.05um Colloidal Silica Suspension	100rpm	2-3 minutes	Hand Polished

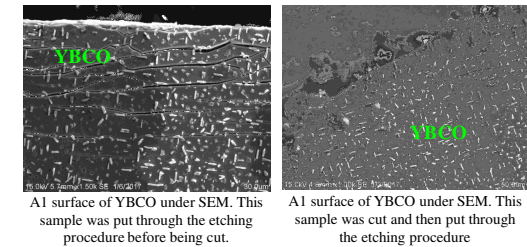


Experimental Procedure

- ❑ YBCO samples were cut using a guillotine to replicate shearing damage
- ❑ The specimen is mounted in a longitudinal orientation (A3) to view damage propagation from the shearing site
- ❑ SEM and laser confocal images are taken to document the damage
- ❑ Measurements are taken from the images to quantify damage length
- ❑ To view the damaged superconducting layer from orientation A1, etchants are used to remove the copper and silver that surround the internal layers of the tape
 - ❑ Ammonium peroxydisulfate: removes the outer copper layer
 - ❑ Silver etchant comprised of one part ammonium hydroxide, one part hydrogen peroxide, and two parts methanol by volume: removes the silver layer



Research Goals



- ❑ The right image shows periodic crack propagation while the image on the left shows sporadic cracking with large areas of the superconducting layer missing completely
- ❑ The variance in cracking may indicate that the copper and silver encasing the tape play a role in crack propagation
- ❑ Research will now be centered on a novel sample preparation method that will hopefully eliminate the need for shearing and allow for more accurate delamination tests. By using etchants, the edges of the YBCO tape will be chemically removed reducing edge defects, which have been shown to impact delamination strength.

Results

So What?

Understanding and characterizing structural problems within YBCO is the first step in finding a solution. The ultimate goal is to allow the production of consistent, high-quality YBCO for medical and high energy physics applications.

- ❑ Cracks propagate roughly 48um inward from the shearing site
- ❑ To calculate this value, samples were analyzed in longitudinal cross-section, represented by face A3, and as a flat surface after an etching process, represented by face A1
- ❑ The two orientations both showed similar ranges of crack propagation from the shearing site
- ❑ The images below are all of a longitudinal cross section of YBCO (A3)

