# STATISTICAL ANALYSIS OF ELECTRO-MECHANICAL PROPERTIES OF Ag/Mg SHEATHED $Bi_2Sr_2CaCu_2O_{8-x}$ TAPES USING WEIBULL DISTRIBUTION

A.L. Mbaruku, J. Schwartz (NHMFL/FSU, Mechanical Engineering)

## Introduction

High temperature superconducting (HTS) tapes are promising conductors for applications in high field superconducting magnets greater that 20 T. In our earlier work [1], it was shown that these tapes have varying microstructure along the length. It is therefore important to make a statistical analysis on both the mechanical and superconducting properties for these tapes. Weibull distribution has been used to characterize mechanical properties of metals and ceramic materials [2, 3] and used in this work to study the electrical and mechanical reliability as a function of applied strain. Higher reliability is required in operation of all superconducting devices.

## Experimental

Samples were from same tape batch supplied by Oxford Superconducting Technologies (OST). Batch average $I_c$ (4.2 K, self field) from six samples is 452 A with a standard deviation of 54 A. Dimensions are 5.00 mm by 0.21 mm and 45 mm long. Samples were mechanically strained at room temperature to determine mechanical properties and yield strain. Then twenty-four replication samples were strained to the yield strain and their critical currents measured at 4.2K self-field, using a four-point method with 1μV/cm criterion.

## Results and Discussion

The (average?) tape's properties are: Young's modulus =70 GPa, yield stress (0.2% off-set) = 119 MPa, the ultimate strength = 127.5 MPa and the strain at yield = 0.349%. Weibull shape parameters are 14.34 and 3.84 for yield stress and critical current respectively, which indicates that electrical failure is more likely than mechanical failure. The scale parameter for yield stress indicates that 36.8% of samples have a stress of 130.88 MPa or less at yield point. The scale parameter for critical current indicates that 36.8% of the samples have 354.14 A or less at yield point. The Weibull distributions for the yield stresses and the critical currents are shown on Fig. 1 (a and b).

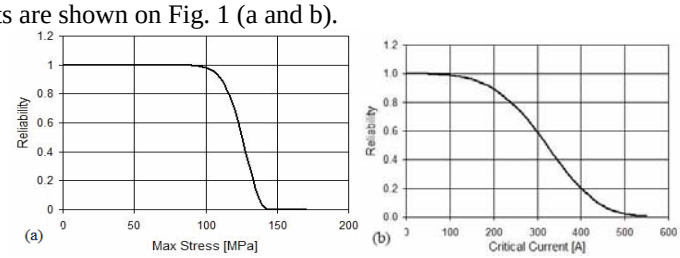


**Figure 1.** Weibull distributions for $Bi_2Sr_2CaCu_2O_{8-x}$ when strained to 0.349% strain (a) stress and (b) critical current.

## Conclusions

Variations in the electro-mechanical properties have been observed and are believed to be largely contributed to by the microstructural differences along the different sections of the tape.

## Acknowledgements

This work was supported by the NSF through the NHMFL.

## References

[1] Mbaruku, A.L., *et al*., IEEE Trans. Appl. Supercond., **13** #2, 3522-3525 (2003).
[2] Pastor, J.Y., *et al*, Journal of European Ceramic Society, **25,** 1225-1223 (2005).
[3] Fernandes, J.C. *et al*., Ceramics International, **26,** 203-206 (2000).