Effects of Overpressure Conditions on the Porosity of Bi-2212 Superconducting Wires

Grant Hawkins, Chris Hopp, Alexandra Putney, Dr. Matthew Jewell

Materials Science & Engineering Program • University of Wisconsin – Eau Claire

Introduction

- Bi$_2$Sr$_2$CaCu$_2$O$_{8+X}$, abbreviated as Bi-2212, has shown promise as a high-temperature superconducting material for use in powerful magnets.
- The material's brittle character makes it difficult to work with.
- Because of this, additional study is necessary to better understand the microscopic properties of Bi-2212.
- One area of note is how the properties of Bi-2212 wires change after different pressure conditions are applied to them during heat treatment.
- This project used image analysis software and techniques to analyze SEM images of Bi-2212 wire samples that had been exposed to 10, 20, 50, and 100 bar overpressure conditions.

Acknowledgements

This work was financially supported by the U.S. Department of Energy (DoE), Office of High Energy Physics, award DE-FG02-13ER42036, and benefited from the Materials Science and Engineering Center at the University of Wisconsin – Eau Claire. This study was supported by the UW-Eau Claire Blugold Fellowship Program which is jointly funded by Differential Tuition and the UWEC Foundation.

Results and Analysis

Image analysis software was used to measure the area of all objects for all thresholds.

Graphs were constructed with Microsoft Excel

This is a graph of average porosity percentage, which is found by dividing the porosity area by the total nonsilver area. It shows a similar trend to that of the Porosity Area graph.

This graph shows that the nonsilver area also varies with overpressure, becoming smaller with increasing overpressure conditions before becoming flat. The current hypothesis for why this occurs is that the overall size of the wire is reduced when additional overpressure is applied.

Conclusion

- Bi-2212’s porosity is greatly reduced as overpressure is increased. The nonsilver area is reduced less dramatically
- This understanding helps us to interpret the electrical and mechanical test results that we obtain from the wire.
- Additional research into the 10 bar question, as well as research into whole wire SEM images, is underway.

The authors thank the UWEC Office of Research and Sponsored Programs and the Blugold Differential Tuition Program for student support at CERCA 2017.