Internal Fracture in High Strength Cu-Al Wire

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A pulsed magnet is a strong electromagnet which is powered by a brief pulse of electricity similar to a lightning bolt. This produces an incredibly strong magnetic field for a very short period of time (milliseconds).

Pulsed magnets create more force than most materials can handle so high strength wire is needed. This wire is made from Glidcop, a copper based metal mixed with aluminum oxide ceramic particles.

To get the correct size wire for the magnet, the copper must be pulled through holes like playdough. Unfortunately, when the copper is pulled cracking or breaking can occur and needs to be found.

The procedure followed to find breaking and cracking (fracture):

1. Section the wire.
2. Cut the pieces with a high speed saw.
3. Mount the pieces in a puck.
4. Sand and polish with diamonds.
5. Use the electron microscope to look for the fracture.
6. Use Photoshop to 'stitch' (put together) the images taken with the microscope.

Discussion:
The investigated fracture is a cup and cone fracture and is a typical way this material breaks based on stress.

It was found by investigation that the alumina particles are evenly distributed, of proper size, and not messed up.

Conclusion:
The wire material was correctly made but was stretched too much due to over pulling which caused the fracture.

Acknowledgements
Robert Goddard  Jose Sanchez  Shannon Gooden  CIRL Staff  Fellow RET Teachers
I appreciate the opportunity to spend the summer learning and researching in the MAGLAB. Thank you for giving me this exciting learning experience. It has been a great benefit academically as well as personally.

This research is funded by DMR1157490

References:
1. Robert Goddard

Example of cup and cone fracture.

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