Analyzing Nanoribbon Structure of Cu-Ag Composites for use in High Tesla Nondestructive Magnets

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The ability to create a pulse of extreme high magnetic fields nondestructively provides researchers with an extraordinary tool for studying fundamental properties of materials, from metals and superconductors to semiconductors and insulators.

Nondestructively means that these magnets can be used repeatedly whereas most high-power pulse magnets routinely explode due to the large forces involved!

To determine the effect of stress on the microstructure of bent Cu-Ag alloy composite wires which are wound for making high energy non-destructive pulse magnets. This copper wire is laced with Ag-Cu nanoribbons in a honeycomb pattern. When extreme forces are applied, it shows superior strength and good magnetic conductivity.

The tesla (T) is used as the SI unit of measurement for very strong magnetic fields while the gauss (G) is commonly used for weaker magnetic fields. 1 tesla = 10,000 gauss.

The world record 100 Tesla Pulse magnet developed at the MagLab endures the equivalent of 200 sticks of dynamite exploding at once.

For comparison, the Earth’s magnetic field is about 50 microtesla, or 0.00005 tesla.

Composite wire cross-sections are stitched together using Photoshop and ImageJ.

The concentration of the coarse microstructure corresponds to a greatly induced strain of wire windings of 6mm in diameter. Strain of 15% and below yields a consistent microstructure and should be suitable for windings of at least 12mm in diameter.

Results

Evaluating microstructure coarseness involved plotting binary images comparing pixel contrast.

The density is multiplied by the average thickness of the Ag-Cu to provide a graph of the relative microstructure thickness.

The average coarseness divided by the spread (Std Dev) of coarse structure is then plotted against the strain induced by the bending stress.

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Thank you for making my summer very memorable and awesome----Not good bye … Until we meet again!

References:


100 Tesla Magnet picture https://nationalmaglab.org/about/around-the-lab/meet-the-magnets/meet-the-100-tesla-pulsed-magnet

Magnetic Earth Diagram http://newscenter.lbl.gov/2014/08/19/nmr-using-earths-magnetic-field/