T_CSUH Bi-Weekly Seminar

Texas Center for Superconductivity at the University of Houston

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"First Experimental Test of the Incorrect Assumption that Continuous Columnar Pinning Centers Produce the Highest J_c in Superconductors"

Friday, September 30, 2005
Room 102, University of Houston Science Center
1:00 p.m. – 2:00 p.m.

Abstract

The improvement of critical current in HTS by optimization of pinning center morphology has been a crucial area for research since the HTS's discovery. In the past decade it has been stated in numerous papers that the optimum pinning centers are provided by continuous columnar defects. This conventional wisdom has never been questioned, nor experimentally tested. This has led several researchers to believe that the highest J_c could only be achieved by means of continuous columnar defects. Columnar defects have been assumed to provide the highest J_c because theoretically they have been shown to maximize the pinning potential. However, pinning theory completely neglects that, as the pinning center density increases, the current percolation is reduced, and hence J_c decreases. Recently we argued that percolation has a larger effect on J_c than previously expected. We proposed that discontinuous pinning centers, which reduce the loss of current percolation, would result in a higher J_c. An experiment was performed to directly compare continuous and discontinuous pinning, using high-energy ions. We now present the surprising experimental result that, in clear contrast with the conventional belief, J_c for discontinuous pinning is much higher than for continuous. This experiment indicates that the superior percolation achieved by discontinuous pinning outweighs the decrease in pinning potential. Record $J_c \sim 300$ KA/cm^2 at 77 K was achieved in melt-textured YBCO for pinning which was 67% discontinuous. This work stands as the first experimental test of the postulate that continuous columnar pinning centers produce the highest J_c, and shows that the postulate is incorrect.

Bio

Dr. Alberto Gandini received his B.S. in Physics at the University of Milan, and his Ph.D. from the University of Houston in 2001. He is currently a Research Scientist in the Department of Physics at the University of Houston. His interests have been focused on advancing the current transport properties in BiSCCO tapes, and melt-textured YBCO via chemical doping and irradiation techniques. The present work of Dr. Gandini involves the use of heavy ion irradiation to probe the effect of current percolation and pinning morphology on HTS properties such as critical current and critical temperature. Resent results include the highest critical current in melt-textured YBCO. He also works on HTS applications in biomedicine such as cell separation by high magnetic field gradients in collaboration with the UT M.D. Anderson Cancer Center.

Persons with disabilities who require special accommodations in attending this lecture should call (713) 743-8210 as soon as possible.