PRELIMINARY MEASUREMENTS OF THE CRITICAL CURRENT DENSITY OF $Nb_3Al_{0.8}Ge_{0.2}$ RIBBON

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We have been able to fabricate ribbons with the nominal composition $Nb_3Al_{0.8}Ge_{0.2}$. These ribbons have cross sections of 0.01 cm x 0.25 cm, and have, according to x-ray diffraction, almost entirely the beta-tungsten crystal structure. Transition temperatures for such ribbons generally run from 17 to 19.5 K at midpoint (we have not yet measured T_c for the ribbons reported on here), depending on processing. We intend to report the details of our processing at a later date. At present, we can report some of the results of our first measurements of the critical current density in transverse applied magnetic fields up to 15.0 T, and temperatures from 4.2 to 16 K.

Measurements

Resistive measurements were made with the usual four point geometry, with the field parallel to the 0.25 cm side of the ribbon, and transverse to the applied current. Measurements were made at the Francis Bitter National Magnet Laboratory, in a water-cooled Bitter-type solenoid. Current and voltage leads were connected by indium solder, and the temperature of the specimen was regulated by a small resistive heater and a metal heat leak to the liquid helium bath. Temperatures were measured by both capacitive (glass) thermometers and germanium thermistors thermally anchored to the specimen by conductive grease. Thermal drift during any one run was always less than 0.5 K. The specimens were all protected by small parallel copper shunts, with dimensions similar to those of the specimens. The criterion for transition was as follows: the current was swept with the field fixed, and the I-V characteristic determined out to 10-50 μV. The curve was then extrapolated back to zero voltage, and the current value at which the zero volt intercept occurred was taken as I_c.

Results

Figure 1 shows J_c vs T for various fields up to 15.0 T for two of our specimens. The behavior of specimen No. 2 is remarkable in two ways: J_c is quite insensitive to temperature, and it is carrying current densities of 5-10 x 10^3 A/cm^2 at 15.0 T at temperatures which may be only 5^o below its transition temperature. The relative insensitivity of J_c to temperature is probably due to the "peak and dip effect," as Fig. 2 shows. Because the "peak" <u>and</u> the "dip" move to the right as temperature decreases, dJ_c/dT can be zero or even positive for some range of applied field.

Remarks

The ribbon is quite brittle, and sufficiently unstable magnetically that the small copper shunts were necessary to avoid destruction of the specimen by quenching. Although the observed critical current densities are too low to be generally useful, the severe peak and dip effect indicates by its presence that pinning can probably be improved considerably. If these three problems, J_c, stability, and bendability, can be surmounted, then the ribbon will be thoroughly practical. As it is, the observed J_c's at the elevated temperatures and fields should provide us with the impetus to attack such problems, which are at best difficult ones.

Acknowledgments

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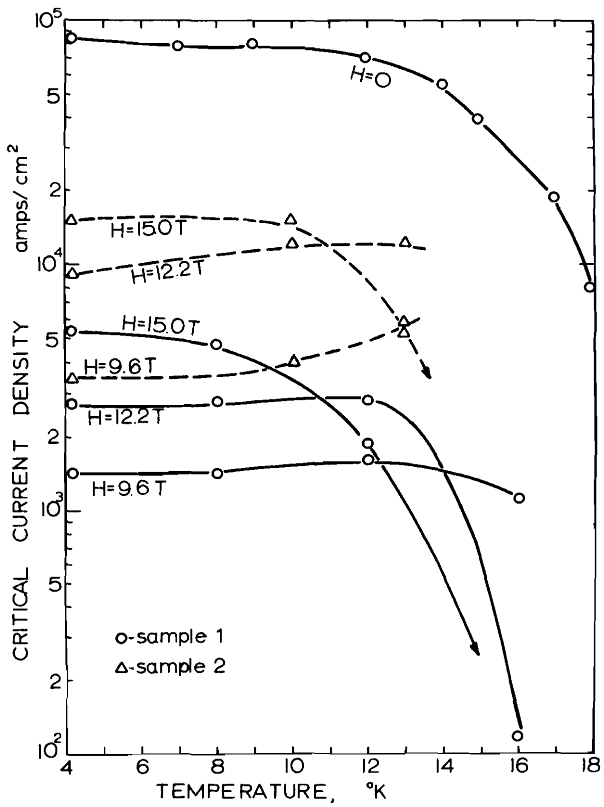

Fig. 1. J_c vs T at various applied transverse fields, for two specimens. Specimen No. 1 was annealed for 100 h at 725°C and should have a higher T_c (by about 1.5°) than Specimen No. 2, which was not annealed.

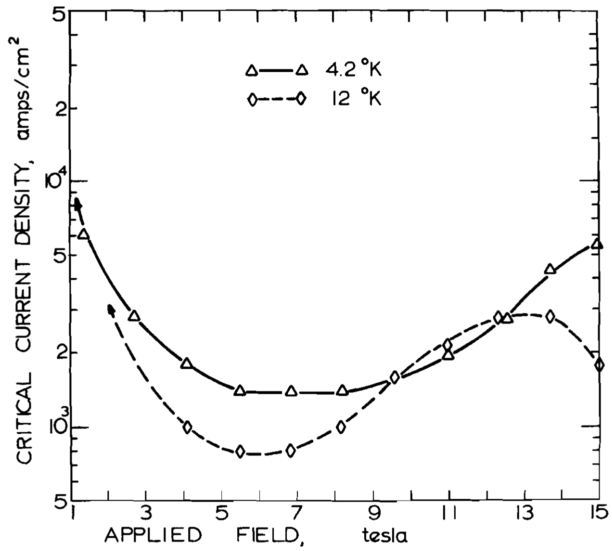

Fig. 2. J_c vs H at various temperatures for Specimen No. 1, showing the motion of the "peak and dip," and explaining the relative insensitivity of J_c to T at certain applied fields, and also positive dJ_c/dT at other fields.