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The abnormal behavior of the resistive transition to the normal state of superconducting high-textured Nb-Ti tapes just below Hc2

At present, superconducting materials have already found application in such areas of science and technology as high energy accelerators (Tevatron, LHC, NICA, etc), nuclear fusion devices (T7, ITER, EAST, etc.), medical tomography, transport and others. The progress of the superconducting industry requires the further development of analytical tools for modelling the electro-physical behaviour of both used superconductors and those being developed.
It is well known that niobium-titanium tapes are quite suitable objects for studying electrodynamics of practical superconductors. Here, by electrodynamics is meant a more general concept than just pinning and dynamics of vortex matter. For example, the nature of phase transitions of superconductors to the normal state under the impact of a transport current under isothermal conditions is still a divisive issue.
In this work we report the results of studying the resistive properties of Nb-Ti tapes in high magnetic fields close to the upper critical field (Hc2). The current-voltage characteristics (CVCs) show "abnormal"(non-thermal) hysteresis opposite by sign to a common thermal one caused by Joule self-heating. There are two threshold current points: below the first point CVC are reversible, then, up to the second threshold value, there is irreversible (hysteresis) behaviour, and finally above the second threshold value, when the resistivity is close to normal, the CVCs are reversible again. It has been reported several times that such behaviour is observed on granular superconductors, and this is a manifestation of the superconducting-glass state. In conclusion, we discuss the nature of the granular properties of Nb-Ti tapes in high magnetic field and the relation with other observed effects, such as the irreversibility field and the anisotropy of the upper critical field.

Summary

We have investigated the electrodynamic features of high-textured superconducting Nb-Ti tapes in high magnetic fields.It is shown that the whole volume of experimental data can be described if we abandon the hypothesis of a phase transition as an explanation of irreversibility field phenomenon and go over to the hypothesis of macroscopic inhomogeneity. This hypothesis implies the existence of two superconducting components with different upper critical fields which naturally arise as a result of the production process.

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