ON VOLTAGE FLUCTUATIONS IN RESISTIVE STATE OF SUPERCONDUCTING Y—Ba — Cu—O CERAMICS

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Up to now several works have been published describing voltage fluctuations in current carrying samples of high-T_c supeconducting ceramics at temperatures near the phase transition point. In all cases the 1/f noise was found, its normalized intensity being dependent on temperature, geometry and the preparation technology of samples used in experiments (e. g., see /1/).

At the same time, of special interest is the investigation of fluctuations at temperatures far below the transition point. It is well known /2/ that the appearance of a non-zero potential drop between certain points of a superconductor is not always connected with a transition of the whole material in the normal state. For type-II superconductors a generation of potential can be caused by a viscous movement of the vortex structure across the sample.

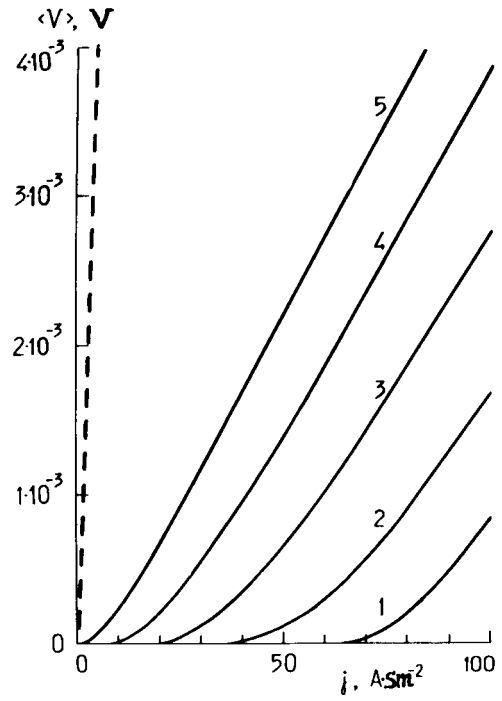

Fig. 1

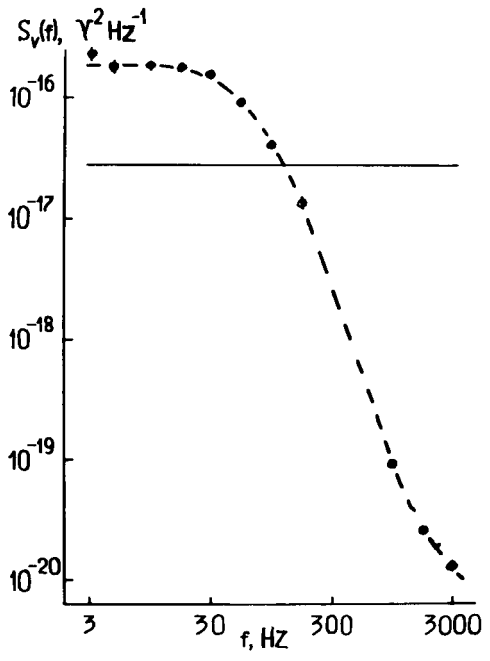

Fig. 2

For the low-frequency limit of the spectral density of voltage fluctuations in the case of an uncorrelated flow of vortices, the relation holds

$$S_V(f) = 2\,\Phi_0 <V>,$$

where Φ_0 is the flux quantum and $<V>$ is the mean voltage drop across the potential contacts. This relation was verified by several authors in experiments with 'classical' type-II superconductors /2/.

The results obtained for high-T_c superconducting samples /3/ reveal a substantial difference in the nature of the resistive states of these materials from those of early studied low temperature superconductors. The measurements were done with the use of thin (0.2 mm) plates of Y—Ba—Cu—O ceramics of KIB-1 type. Figure 1 shows V—I characteristics of samples at liquid nitrogen temperature in magnetic fields perpendicular to their biggest surface; the field values are shown by numbers over the curves. Figure 2 presents the voltage fluctuation spectrum in the 125 Oe field. The solid straight line denotes a magnitude and a frequency range of existence of the low-frequency spectral limit for the case of uncorrelated vortex flow being the source of the measured voltage drop.

It can be seen that a discrepancy between the theory and the experiment reaches more than three orders of magnitude (the spectral point at 3 kHz). Similar significant discrepancies were obtained at various experimental conditions. For example, in the 1.8 Oe field and at the 2.7 mV mean voltage drop the theoretical value is 150 times as large as the experimental one. This permits us to conclude that in contrast to early investigated low-temperature type-II superconductors, the resistivity of high-T_c superconductors is not caused by the uncorrelated flow of trapped magnetic field quanta induced by the Lorentz force.

REFERENCES

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