NEUTRON DEPOLARIZATION MEASUREMENTS OF HIGH-TEMPERATURE AND LOW-TEMPERATURE SUPERCONDUCTORS

N.K.Zhuchenko, R.Z.Jagood

The problem of investigation of magnetic fluxes structure in HTSC materials is important not only from clearly scientific viewpoint. Such studies directly relate to a search for ways to increase critical currents in strong magnetic fields and to other applied tasks. An interesting information may be obtained from experiments on neutron depolarization [1,2]. According to this method a beam of thermal neutrons with polarization P_0 is passed through a sample under test which is followed by measuring polarization P after the sample.

Magnetic induction inside the sample having a component perpendicular to a direction of internal field and initial neutron polarization P_0 determines a ratio P/P_0 for a superconduction mixed state (applied field $H > H_{c1}$). An average angle of a flux lines deflection from an applied magnetic field direction can be caused by pinning forces with an account for crystal or form anizotropy (by demagnetizing factor).

Our experiments presented in this work were aimed to find out possible causes of originating of magnetic induction inhomogeneity, leading in our experimental conditions to neutron depolarization in HTSC ceramic materials (external fields $H<16\ kOe$ and $T \geq 4.2\ K$).

Papers [1,2] give the results of measurements in ceramics high-temperature 1—2—3 superconductor, low-temperature granulated $SnMo_6S_8$ as well as depolarization measurements on textured strongly anizotropic polycrystal compound $Bi_2Sr_2CaCu_2O_{8-x}$ on a classic hard izotropic superconductor 0.5 Nb — —0.5 Ti.

The measurements have been carried out in conditions ZFC and FC in the fields up to 16 *kOe* at $T = 4.2$ *K*. For bismuth compound an external field was orientated both H $\perp$ "c" and H $\parallel$ "c". These measurements have led us to a conclusion that random local magnetic field resulting from interaction of local dipole magnetic fields (both diamagnetic and paramagnetic) with an external field creates in grains within the framework of a critical state model magnetization random by magnitude and direction relatively to an external field and initial neutron polarization.

A scale of inhomogeneous magnetization on the grains size can be of the same order as *M* granular i.e. $M_\perp \sim M_\parallel \sim M$. And though $\langle M_\perp \rangle = 0$ the second moment $(m_\perp - \langle m_\perp \rangle)^2$ affects neutron depolarization effects in disperse (i.e. having low field dynamics) materials due to the effect of local dipole magnetic fields because of grains' demagnetization factor. The paper also interprets hysteresis aspects of depolarization measurements.

References

1. Dmitriev R.P., Jagood R.Z., Zhuchenko N.K., Volkov M.P., Leyazowsky E.I., Z.Phys.B. 1991. V.83. P.155.

2. Dmitriev R.P., Jagood R.Z., Zhuchenko N.K. Preprint LNPI-1727. Leningrad. 1991. 17 p.