VORTEX STRUCTURE MOBILITY AND PENETRATION DEPTH MEASUREMENT IN $Bi_2Sr_2CaCu_2O_{8+\delta}$ TEXTURED SAMPLE

S.G.Barsov, A.L.Getalov, S.G.Karabashev*, V.P.Koptev, L.A.Kuzmin, S.M.Mikirtychyants, A.S.Nigmatulin*, N.S.Sidorov, G.V.Shcherbakov**

* Moscow Institute of Steel and Alloys, Moscow
** Solid State Physics Institute, Chernogolovka

As the previous μSR-studies of $Bi_2Sr_2CaCu_2O_{8+\delta}$ textured sample have shown the temperature dependence of the penetration depth is significantly different from the law $\lambda(T) = \lambda(0)\ [\ 1 - (T/T_c)^4\ ]^{-1/2}$ which is typical for the 1.2.3.-compound [1]. Besides, the large mobility of the remnant magnetic flux (FrFC) has been observed in the temperature region 40—60 K much more below the superconducting transition temperature $T_c \approx 82\ K$.

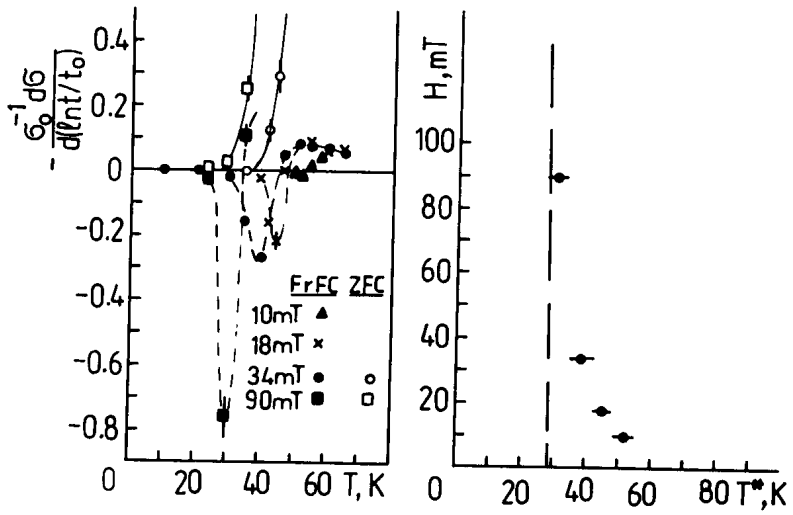

Fig.1. Dependences of relative rate of local field dispersion σ for FrFC and ZFC on temperature (on the left) and dependence of suggested melting temperature T^* on H (on the right). Dashed line is interpolation of data published in [6] into small field area

The recent exploration of the magnetic flux behaviour at the magnetization of the sample after zero field cooling (ZFC) confirmed the data obtained for FrFC [2]. In the both cases the gigantic flux creep occured only at the temperatures above some T^* depending on the external magnetic field (fig.1). As it follows from the comparison of the ZFC and FrFC data near this temperature the remnant magnetic flux moving appeared even inside the areas where the gradient of the magnetic flux was initialy absent. It is difficult to explain these features in the framework of the thermally activated flux creep only and the possibility of the vortex structure melting could be taken into account [3]. It must be noted that the obtained dependence of T^* on the external magnetic field value was in qualitative agreement with the theoretical predictions for the melting temperature if the pinning is taken into account [4].

Since the spontaneous vortex's moving in the suggested "liquid" phase of the vortex structure at $T^* < T < T_c$ could modify the relationship between the penetration depth and the measured dispersion of the local vortex magnetic fields. The temperature dependence of $\sigma = \text{const} <\Delta h^2>$ was obtained for the different values of the external magnetic field (fig.2). The data had a good coincidence for all the temperatures uncluding the regions near T^* which in the units of T_c was equal to 0.38, 0.49 and 0.56 for 90, 34 and 15 mT

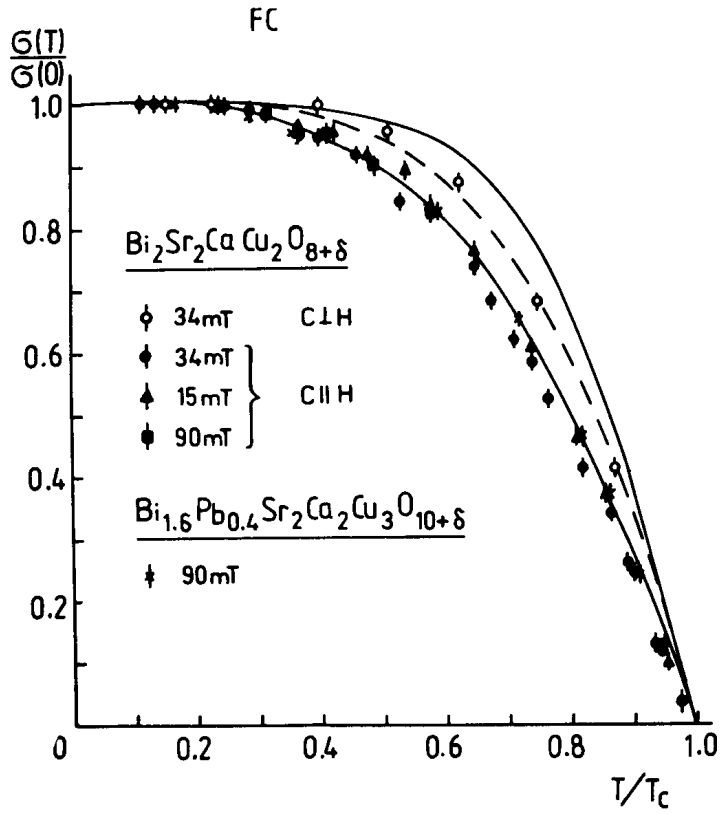

Fig.2. Temperature dependences of local field dispersion for FC. T_c = 82 *K* for sample of 2212-phase and T_c = 105 *K* for ceramic one of 2223-phase. Solid lines represent results of theoretical calculations for strong coupling case in "clean" (down) and "dirty" (upper) limits [5]. Dashed line — $1 - (T/T_c)^4$

respectively. Thus, it is possible to use $\sigma(\tau)$ for the determination of $\lambda(T)$ which was well fitted by theoretical functions calculated in the assumption of the strong coupling [5].

Reference

1. Barsov S.G., Getalov A.L., Koptev V.P. et al. Preprint LNPI-1535. 1989. 31 p.
2. Barsov S.G., Getalov A.L., Koptev V.P. et al. Preprint LNPI-1734. 1991. 15 p.
3. Barsov S.G., Getalov A.L., Koptev V.P. et al. //Hyperfine Int. 1990. V.63. P.87.
4. Yeh.N.-G. //Phys.Rev.B., 1989. V.40. P.4566.
5. Gammel P.L. et al. //Phys.Rev.Lett., 1988. V.61. P.1666.