TRANSPORT CRITICAL CURRENT MECHANISM INVESTIGATION IN GRANULATED SUPERCONDUCTORS BASED ON YBaCuO-CERAMICS UNDER FAST REACTOR NEUTRON IRRADIATION

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The modification of the HTSC-materials properties under neutron irradiation presently being studied. The interest in these investigations arises from the possibilities of the practical application of the new materials in the ionization fields. It was found the "small fluence effect" by investigation of changing the properties of YBaCuO-ceramics under low-temperature (30 K) irradiation by fast (E≥1 Mev) reactor neutrons in the fluence field (10^{16}–-10^{18}) cm^{-2} which was manifested in increasing of superconducting transition temperature (Tc) at the fluence = 10^{18} cm^{-2} and in Tc decreasing by following irradiation [1]. However, the theoretical model suggested in [1] was not explaned the nonmonotonously critical current dependence on various particle fluence on initial stage of irradiation which was experimentally estimated in different workes [2–5]. The assumptions underlying the model presents the granula contacts area changing due to neutron irradiation by initial fuence ($\leq 5 \cdot 10^{17} cm^{-2}$). It was assumed that a irradiation causes the origin of homogeneus all-round expansion and, hence, of homogeneus average pressure in material [6]. The volume increasing caused by irradiation is equal [6]:

$$\Delta V(\Phi) = 4C(\Phi)(1 + (4/3)(\mu/K)) \quad (1)$$

where $C(\Phi)$ – coefficient which depends on neutron fluence, μ – Young modulus, K – all-round expansing coefficient. It can be shown that the granula contact area (S) in material is the function of Φ : $S = S(\Phi)$ and a critical current Jc between granula as a function of neutron fluence may be presented as [2]:

$$J_c = J_c^o + J_c^o \cdot S(\Phi) \quad (2)$$

where J_c – transport critical current between granula, J_c^o – critical current before irradiation, S(Φ) – granula contact area. In the framework of the presented theory the increasing of the transport critical current will be observed by following conditions:

- the superconductor must have a granulated structure and it must be true the knowledge of Josephson environment for it;
- the granula mast be sufficiently great (radius $\geq 8 - 10$ mkm);
- the irradiation must be occurs by low temperature (for example, in low-temperature helium loop).

The comparison between calculation in framework of the presented model and experimental data [7] is shown in Fig.1. Thus, on the basis of a presented model and comparison between calculation and available experimental data, it must be assumed that the nonmonotonously dependence $Jc(\Phi)$ is due to fluence changing of the intergranula contacts area rather then accumulation of the pinning centers iside the granula.

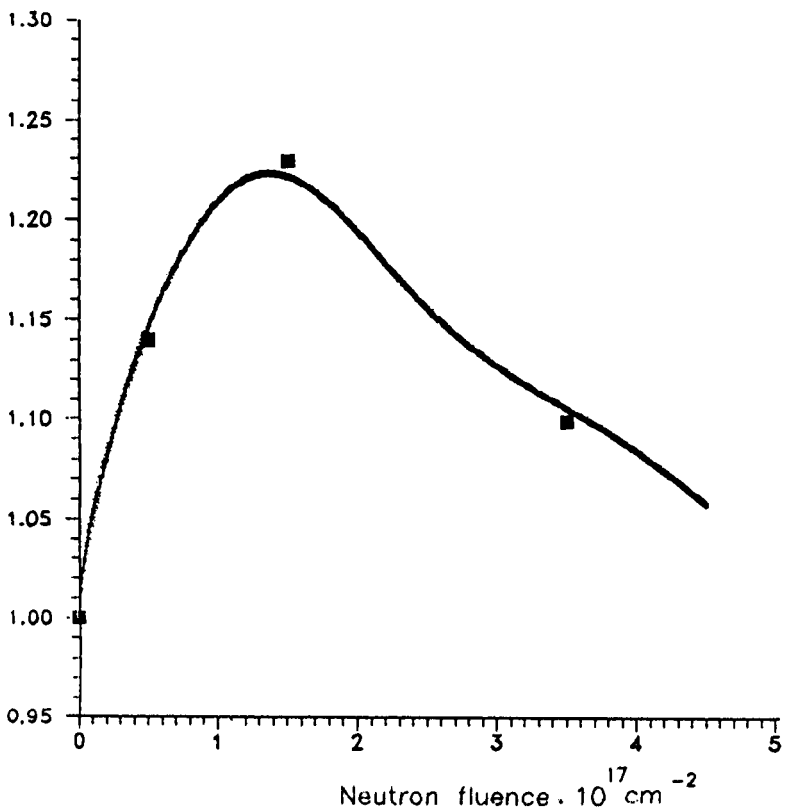

Fig. The transport critical current as a function of the fast neurton reactor fluence.Symbols:shaded squares – experiment [7], solid line – theoretical curve calculated to the presented model

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