INVESTIGATION OF MAGNETIC ORDERED STATE IN $YBa_2Cu_3O_{6+x}$ ($0.06 \leq x \leq 0.32$) BY MUONIC METHOD

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The antiferromagnetic state occuring in $YBa_2Cu_3O_{6+x}$ is characterized by the sharp decreasing of the magnetic transition temperature with the increasing x near the transformation to the superconducting region. This is obviously caused by the influence of the implanted charge carriers (holes) on the magnetic exchange interaction of the copper atom spins. In the present work the effect of the oxygen concentration on the internal field distribution parameters was experimentally studied by the polarized muons [1]. It was shown that in the samples with $0.06 \leq x \leq 0.32$ the muon polarization behaviour at $T < 200\ K$ corresponded to the case of the quasistatic ordering of the magnetic moments. The muons were localized in the two main positions inside the elementary cells, the population of which was practically independent on x. The dispersion of the internal local fields for one of them (65—55% of muons) being much larger than fields average value was the same and nearly constant within experimental errors at $T < 150\ K$ for all the studied samples. The temperature and concentration dependencies of the field distribution parameters for another muon's position are represented in fig.1 and fig.2. The increase of the relaxation rate σ at $T > 200\ K$ was, perhaps, due to the muon diffusion while the real magnetic transition temperatures were not lower than 300 K.

As it follows from the data obtained at 5—10 K neither the average value of the internal magnetic fields (fig.1, $\nu = \text{const} \langle h \rangle$) nor its dispersion (fig.2, $\sigma^2 = \text{const} \langle \Delta h^2 \rangle$) changed at $x \leq 0.20$. The further increase of x led to the appearence of the disordering in the magnetic subsystem producing the increase of σ. But the magnetic moments value seemed to be unchanged because the precession frequency ν was nearly constant. In addition the increase of σ with the decrease of the temperature below 100 K was found for all the samples. In general, this phenomena could be the result of the "freezing" of the hole spins [2] but the detailed analysis requires a further theoretical and experimental studies.

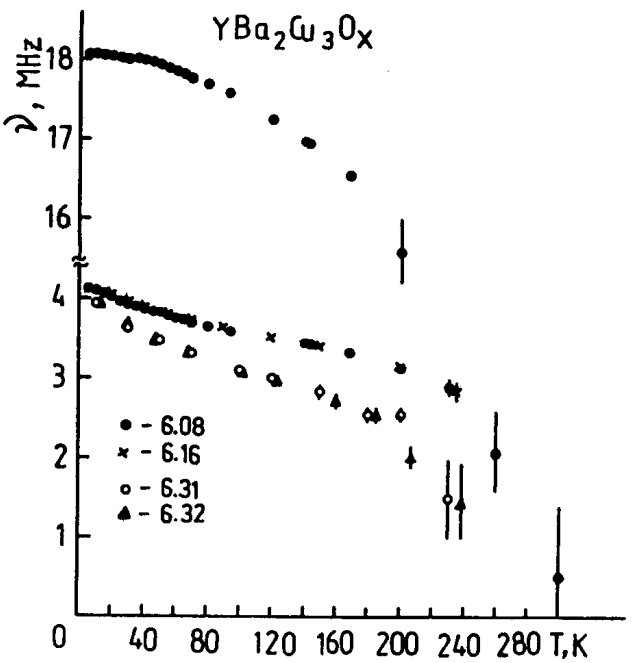

Fig.1. Dependences of muon precession frequency ν in absence of external magnetic field

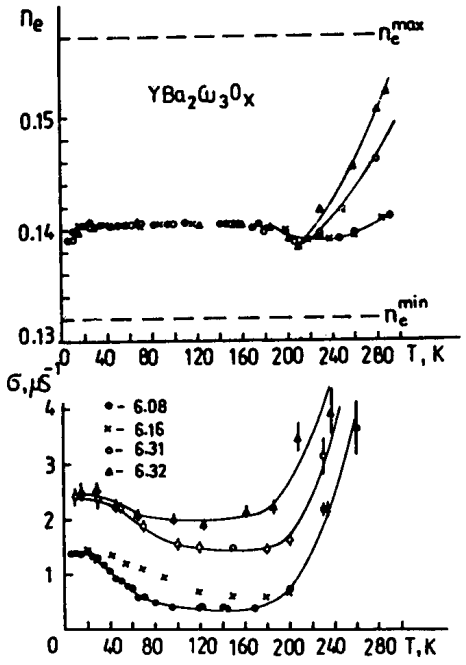

Fig.2. Temperature dependences of integral positron yield n_e and of relaxation rate σ in ceramics $YBa_2Cu_3O_{6+x}$. Lines were drawn for eyes

It is important to note that despite of the mentioned effects associated with the disordering of the magnetic moments no evidences for the formation of a "spinglasslike" phase have been observed through the whole explored temperature and concentration region since the magnetic system behaviour remained reversible.

References

1. Barsov S.G., Getalov A.L., Koptev V.P. et al. Preprint LNPI-1735. 1991. 18 p.
2. Aristov D.N., Maleyev S.V. Preprint LNPI-1587. 1991. 24 p.