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HIGH T_c SUPERCONDUCTING

$\text{HoBa}_2(\text{Cu}_{1-x}\text{Fex})_3 \text{O}_{7-y}$

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HIGH T_c SUPERCONDUCTING $\text{HoBa}_2(\text{Cu}_{1-x}\text{Fe}_x)_3\text{O}_{7-y}$ *

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We have made dc magnetization ($x=0$, and 0.05) and ^{57}Fe Mossbauer spectroscopy ($x=0.05$) measurements of $\text{HoBa}_2(\text{Cu}_{1-x}\text{Fe}_x)_3\text{O}_{7-y}$ between room temperature (RT) and 20K. Based on RT x-ray diffraction results, all samples are single phase and either orthorhombic ($x=0$) or tetragonal ($x=0.05$). Magnetization measurements of the two materials are shown in Figs. 1(a) and (b). Based on these measurements the onset T_c is 90K for $x=0$ (orthorhombic) and 48K for $x=0.05$ (tetragonal). Paramagnetic behavior is observed in the tetragonal sample. The ^{57}Fe Mossbauer spectra between RT and 20K are nearly identical, consisting of three superposed quadrupole doublets. These results are consistent with those previously reported for $\text{YBa}_2(\text{Cu}_{1-x}\text{Fe}_x)_3\text{O}_{7-y}$.^[1] The RT spectrum is shown in Fig. 2. The spectral contributions of the three doublets D-1, D-2 and D-3 are: 58, 34 and 8 percent respectively. The nearly 2:1 ratio of the D-1 and D-2 intensities suggest that these correspond to the Cu II and Cu I sites. D-3 appears to be associated with substituted Fe in an Ho or Ba site.

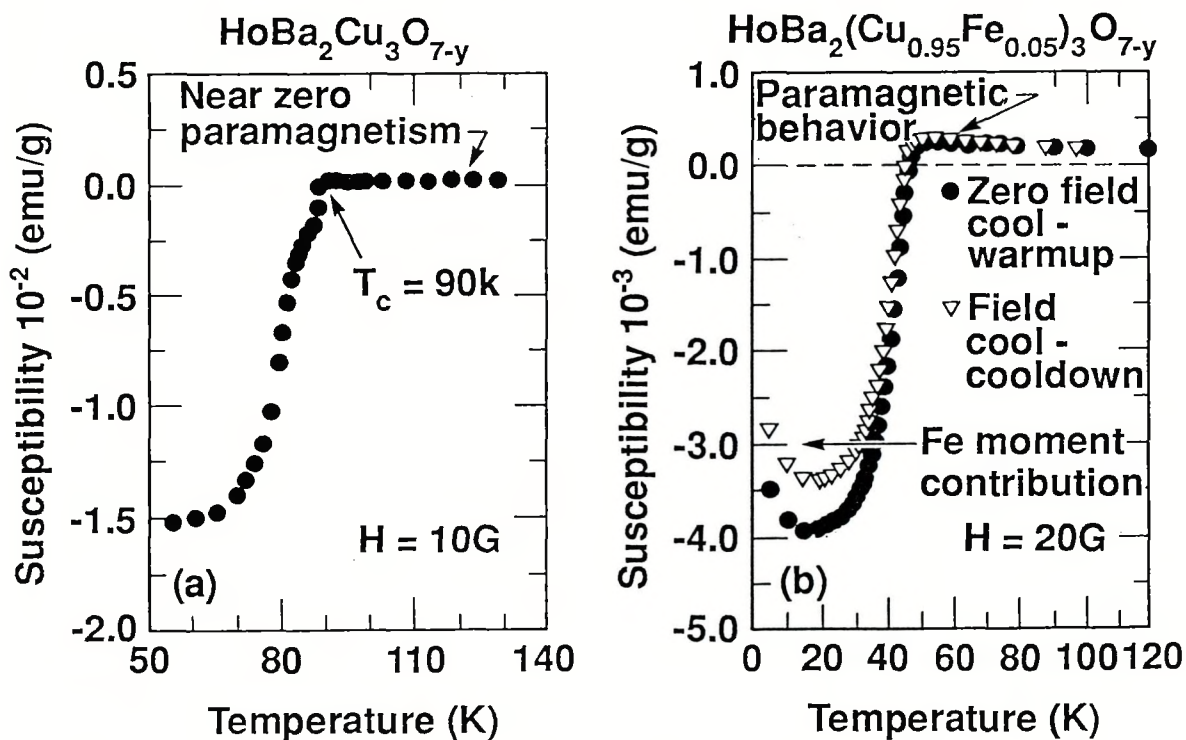


Fig. 1. dc magnetization results for (a) $\text{HoBa}_2\text{Cu}_3\text{O}_{7-y}$ and (b) $\text{HoBa}_2(\text{Cu}_{0.95}\text{Fe}_{0.05})_3\text{O}_{7-y}$. The onset T_c for (b) is 48K.

The isomer shifts vary with temperature while the quadrupole splittings are virtually unchanged. The quadrupole splitting and isomer shifts of the three doublets suggest that the Fe valence states at the D-1, D-2 and D-3 sites correspond to those of low-spin, Fe II and/or Fe III complexes. Low-spin Fe II is diamagnetic but paramagnetic behavior is observed in the tetragonal sample. Therefore, we conclude that the Fe valence state in this sample is predominately Fe III.

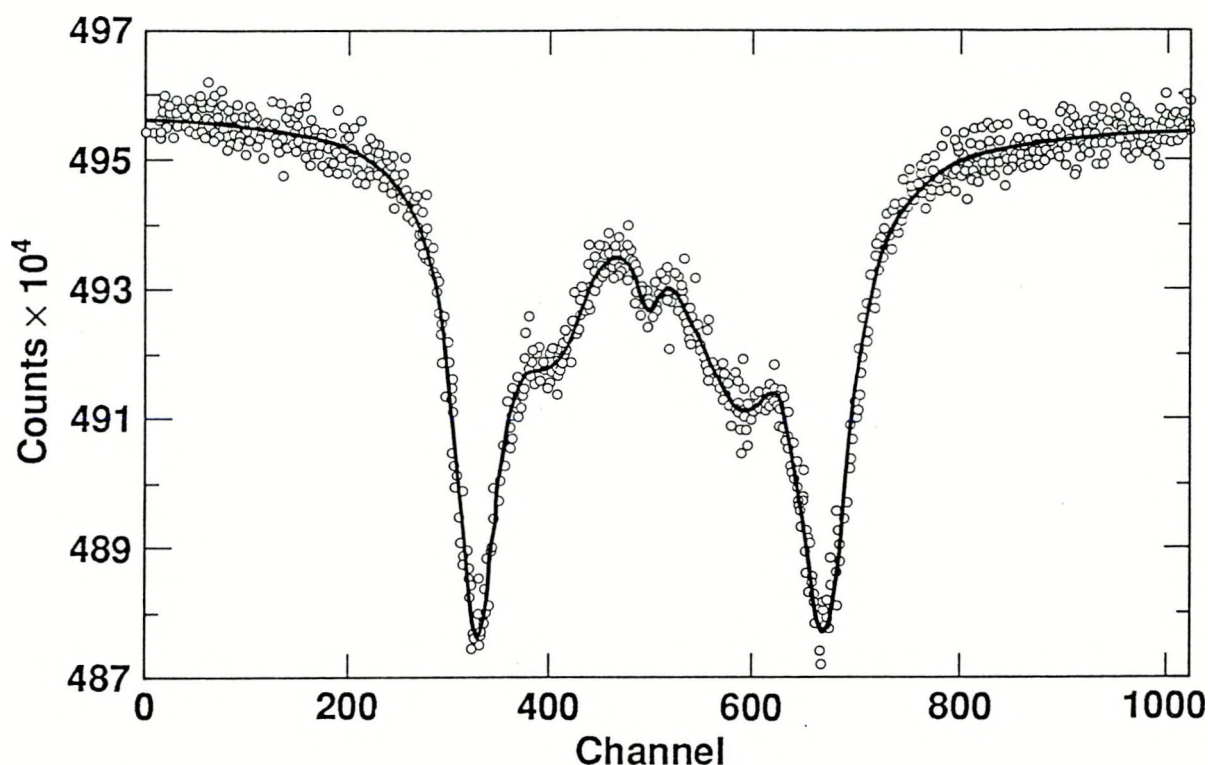


Fig. 2. Fe^{57} Mossbauer spectrum of $\text{HoBa}_2(\text{Cu}_{0.95}\text{Fe}_{0.05})_3\text{O}_{7-y}$ at room temperature. The velocity scale is ± 3.0 mm/sec. The fitted curve represents three superposed quadrupole doublets.

[1] E.R. Bauminger, M. Kowitt, I. Felner and I. Nowik, Sol. St. Commun. 65, 123 (1988), and references therein.

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