ZERO-FIELD SPLITTING OF THE GROUND STATE OF Eu^{2+} IONS IN $EuBa_2Cu_3O_{7-\delta}$ COMPOUND WITH LARGE OXYGEN DEFICIENCY

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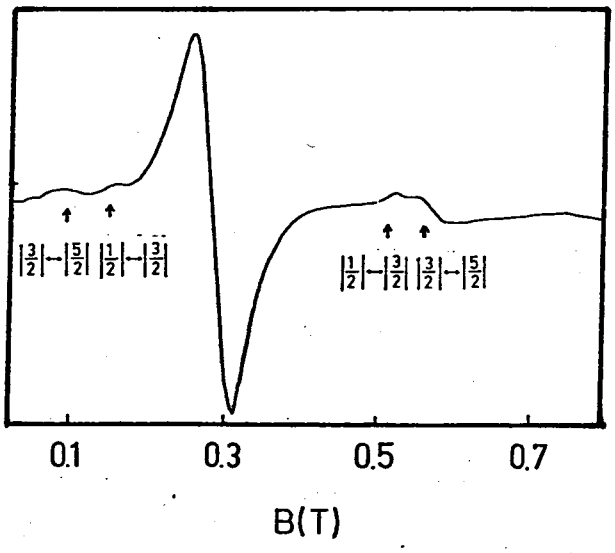
ABSTRACT. This paper shows the existence of divalent europium ions in the oxygen deficient Eu-Ba-Cu-O compound. The zero-field splitting of the S ground state of the divalent europium ions is studied by means of EPR. An approximate value of 0.04 1/cm for the second-order spin Hamiltonian parameter is deduced.

INTRODUCTION. In a previous paper [1] on Eu-Ba-Cu-O in tetragonal phase an EPR signal was tetnatively ascribed to a superexchange interaction between divalent europium ions over oxygen bridges. This communication extends the analysis to the case of an oxygen deficient Eu-Ba-Cu-O sample obtained after additional thermal treatment which revealed the EPR spectrum of divalent europium ions.

RESULTS AND DISCUSSION. The measured sample Eu-Ba-Cu-O in [1] was re-annealed at 450 C for 12 h under O(2) gas flow and then it was slowly cooled to room temperature (RT). In order to receive the oxygen deficient phase, the sam-



ple were submitted to further annealing at 450 °C in flowing He for 5 h following fast cooling to RT in reducing atmos phere. XRD characterization showed that it could be indexed on the base of a tetragonal unit cell with the same value of lattice constant as in [1]. EPR measurements were carried out on powders using a standard Buker 200D spectrometer (ν = 9.41 GHz). Fig.1 presents the EPR spectra taken at 5 K. It contains signals from two different paramagnetic centers. The first signal is very intense and arises from coupled pairs of copper ions [2]. It is centered at g = 2.267(5) with linewidth ΔH = 0.051(1) T. The second signal comes from divalent europium ions. Its spectrum is satisfactory described by the following spin Hamiltonian:

$$H = g_B \mu_B \vec{B}\vec{S} + 1/60\, b_2^0 O_2^0 \qquad (1)$$

where the first term account for the Zeeman energy and the second describes the crystal-field interaction. In the second order perturbation theory the position of the resonance lines (besides the $1/2 \longleftrightarrow -1/2$ transition) for a powder sample are given by the following relation [3]:

$$H = H_o + b_2^0 (M_S - 1/2) - (b_2^0)^2 / 8H_o [2S(S+1) - 6M_S(M_S - 1) - 3] \qquad (2)$$

where $H(o) = h\nu/g\mu_B$ is the central field and $M(S)$ is the component of the spin. Using this relation, a value of the second-order spin Hamiltonian about $b_2^0 = |0.04|$ 1/cm is obtained.

In summary, our results indicate that special thermal treatment could destroy the superexchange bonding between divalent europium ions over oxygen bridges and help to reveal the existence of isolated Eu(2+) ions.

References

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