

# UC Irvine

## UC Irvine Previously Published Works

### Title

EPR, magnetization, and resistivity studies in doped (4-f or 3-d ions) and undoped RBa<sub>2</sub>Cu<sub>3</sub>O<sub>y</sub> high TC superconductors (R=Y,Pr,Nd,Eu,Gd,Ho,Er, or Yb) (abstract)

### Permalink

<https://escholarship.org/uc/item/45738945>

### Journal

Journal of Applied Physics, 63(8)

### ISSN

0021-8979

### Authors

Vier, DC  
Smyth, JF  
Salling, CT  
[et al.](#)

### Publication Date

1988-04-15

### DOI

10.1063/1.340224

### Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

## EPR, magnetization, and resistivity studies in doped (4-*f* or 3-*d* ions) and undoped $\text{RBa}_2\text{Cu}_3\text{O}_y$ high $T_c$ superconductors ( $\text{R} = \text{Y, Pr, Nd, Eu, Gd, Ho, Er, or Yb}$ ) (abstract)<sup>a)</sup>

D. C. Vier, J. F. Smyth, C. T. Salling, S. Schultz, Y. Dalichaouch, B. W. Lee, K. N. Yang, M. Torikachvili, and M. B. Maple  
*University of California, San Diego, La Jolla, California 92093*

S. B. Oseroff  
*San Diego State University, San Diego, California 92182*

Z. Fisk, J. D. Thompson, J. L. Smith, and E. Zirngiebl  
*Los Alamos National Laboratory, Los Alamos, New Mexico 87545*

We have measured electron paramagnetic resonance (EPR), resistivity, and dc susceptibility from 2 to 300 K for the oxide high  $T_c$  superconductors  $(\text{R})\text{Ba}_2\text{Cu}_3\text{O}_y$ , ( $\text{R} = \text{Y, Pr, Nd, Eu, Gd, Ho, Er, Tm, or Yb}$ ). Selected systems were doped with 3-*d* ions ( $\text{Cr, Mn, Fe, Ni, Co, or Zn}$ ) or 4-*f* ions ( $\text{Gd or Er}$ ) which presumably substitute for the Cu or R site, respectively. In the systems studied we have observed an EPR line at low temperatures ( $T < 40$  K), which exhibits an increase in intensity and decrease in field for resonance as the temperature is lowered. The ESR linewidth is also temperature dependent and exhibits a minimum at about 15 K. An additional EPR line that can be associated with a  $\text{Gd}^{3+}$ ,  $\text{Mn}^{2+}$  or  $\text{Er}^{3+}$  ion was observed for those samples where these ions were present as dilute impurities. In some of the samples another EPR signal is observed with properties that depend on sample preparation conditions. The behavior and origin of all lines will be discussed. The variation of  $T_c$  with concentration of the added impurities over the range (1%–15%) will also be presented, and compared with previous studies in other superconducting systems.

<sup>a)</sup> This work was supported by the National Science Foundation under Grants Nos. DMR-86-13858 and DMR-84-11839, the U.S. Department of Energy under Grant No. DE-FG03-86ER45230, and Los Alamos National Laboratories.

## Magnetic ordering and crystal field effects in $\text{REBa}_2\text{Cu}_3\text{O}_{7-x}$ ( $\text{RE} = \text{Gd, Dy, Ho, Er}$ )<sup>a)</sup> (abstract)

B. D. Dunlap, M. Slaski,<sup>b)</sup> D. G. Hinks, C. Segre,<sup>c)</sup> K. Zhang,<sup>c)</sup> L. Soderholm, M. Beno, G. W. Crabtree, W. K. Kwok, S. K. Malik,<sup>d)</sup> I. K. Schuller, J. D. Jorgensen, and Z. Sungaia  
*Argonne National Laboratory, Argonne, Illinois 60439*

Heat capacity, resistivity and magnetic susceptibility data have been used to study electronic and magnetic properties of  $\text{REBa}_2\text{Cu}_3\text{O}_{7-x}$  compounds. Neutron diffraction on the Ho compound shows identical crystal structure to  $\text{YBa}_2\text{Cu}_3\text{O}_{6.8}$ . All the compounds are superconducting at  $T_c = (93 \pm 2)$  K. Magnetic transitions are observed in the heat capacity data at  $T_m = 2.2, 0.95, 0.17,$  and  $0.59$  K for  $\text{RE} = \text{Gd, Dy, Ho, and Er}$ , respectively, and the magnetically ordered state is found to coexist with superconductivity. Estimates have been obtained for the magnetic moment in the crystal field ground state and the energy splitting of the first excited state crystal field level.

<sup>a)</sup> Work supported by the U.S. Department of Energy, BES-Materials Sciences and Chemical Sciences, under Contract No. W-31-109-ENG-38.

<sup>b)</sup> Permanent address: Inst. Phys. Polytech., Krakow, Poland.

<sup>c)</sup> Permanent address: Dept. Phys., Illinois of Technology, Chicago, IL 60680.

<sup>d)</sup> Permanent address: Tata Inst. Fundamental Res., Bombay, India.