

Magnetic Properties of $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ Nanoparticles in Mesoporous Silica

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Parent compound La_2CuO_4 of high temperature superconductor $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ (LSCO) has antiferromagnetic ordering with $T_N \approx 320$ K. As Sr concentration, x , increases, the LSCO exhibits sharp decrease in T_N , and then shows superconducting state ($0.05 < x < 0.26$) below $T_c \approx 40$ K. The magnetic measurement results for the La_2CuO_4 with particle size of 0.22-4.1 μm suggest formation of ferromagnetic anisotropic single-domain clusters at the grain surface.¹ We are interested in the size effects on LSCO nanoparticles with particle size of a few nano-meters. We synthesized LSCO ($x = 0$ and 0.15) nanoparticles in the pores of mesoporous silica SBA-15 and investigated their size effects through magnetic and ESR measurements. X-ray diffraction results indicate formation of the LSCO nanoparticles with particle size of about 11-13 nm. The magnetization curves for $x = 0$, show rapid increase under low magnetic field as in ferromagnetic materials, and the magnetization increases linearly without saturation tendency. In contrast, the magnetization for $x = 0.15$ consistently increases in proportion to magnetic field. The ESR absorption spectra for both $x = 0$ and 0.15 at 77 and 300 K are reproduced by summation of two absorption lines. These experimental results for nanoparticles show the different behaviors from those for bulk crystals and suggest the coexistence of two magnetic components.

¹R. V. Yusupov *et al.*, Phys. Rev. B **76**, 024428 (2007).