

Magnetic properties of composites based on $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$

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Composite materials attract much attention due to the manifestation of unexpected new physical properties in them. Studies of composite compounds with high values of magnetic susceptibility and dielectric permittivity are of interest, which can be used in variety of applications. Here we investigated the materials which consist of two inorganic phases.

One of the components of the composite material is $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ (CCTO). The dielectric behavior of calcium copper titanate (CCTO) exhibits an extraordinary high dielectric constant and shows good thermal stability in a wide temperature range (100–600 K)¹. As the second component of the composite material besides CCTO we chose the strontium hexaferrite $\text{SrFe}_{12}\text{O}_{19}$ (SFO) or lanthanum-strontium manganite $\text{La}_{2/3}\text{Sr}_{1/3}\text{MnO}_3$ (LSMO) to modulate the magnetic properties of the composite.

Magnetic resonance spectra of composites $(\text{SFO})_x(\text{CCTO})_{1-x}$ and $(\text{LSMO})_x(\text{CCTO})_{1-x}$ for $x=0.05$ were measured on an ER 200 SRC (EMX/plus) spectrometer (Bruker) at the frequency of 9.4 GHz with a flow N_2 Temperature Controller RS 232 cryostat (Bruker) in the temperature range from 100 to 300 K. The temperature dependence of the magnetization was measured on a PPMS-9 device in the temperature range from 4 to 300 K.

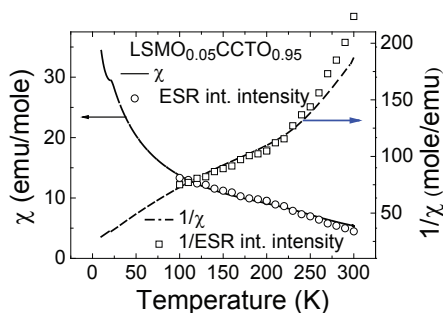


Figure 1. Temperature dependence of direct and inverse magnetic susceptibility in $(\text{LSMO})_{0.05}(\text{CCTO})_{0.95}$.

The temperature dependence of the integral intensity of the ESR signal corresponds to the temperature dependence of the magnetization, f.e. for $(\text{LSMO})_{0.05}(\text{CCTO})_{0.95}$ this fact is presented in Figure 1. Also it was found that strontium hexaferrite (SFO) micro inclusions in composite «magnetize» $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$ at temperatures from 300 to 200 K forming a ferrimagnetic particle near the $\text{SrFe}_{12}\text{O}_{19}$ «core».

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¹ Subramanian M.A. et al. (2000). J. Solid State Chem. 151, 323-325.