Influence of carbon impurity on the magnetic properties of the EuB_6

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EuB_6 is a well-known compound with a colossal magnetoresistance. Its electronic and magnetic properties depend on each other. The influence of carbon doping in the anion sublattice $EuB_{6-x}C_x$ on the magnetic properties of this compound was studied by electron spin resonance (ESR) and by electron transport (ET). The ESR measurements were performed at 9.3 GHz in the temperature range T = 10-300 K, and ET measurements in the temperature range 80-300 K. According to the ESR data, magnetic phase separation is observed for all the samples. The observed two ESR lines correspond to two types of polarons, in which there is a Kondo and an anti-Kondo coupling of the magnetic moments of Eu^{2+} with the magnetic moments of the charge carriers. At x= 0.02 the splitting of the ESR line is observed at 40K as well as EuB_6. However, in $EuB_{5.93}C_{0.07}$ the ESR line splits already at 130 K. At high temperatures, we observe linear resistance R (T) temperature dependencies for all samples that are characteristic for metals. The concentration dependence of the residual resistance R0 is shown in the figure. For a sample with x=0.07 at temperatures below 130 K, R(T) acquires a semiconductor character, which is probably related to the opening of a gap in the spectrum of electronic excitations due to either stronger localization of electrons or changes in the Fermi surface. The dependence R (T) resembles the temperature dependence of the width of the ESR line of this sample. This similarity suggests that both dependencies are due to the same dissipative processes in the systems of localized magnetic moments and current carriers. It is obvious that the tetravalent carbon, penetrating the sub lattice of the trivalent boron, must be an electron donor. In accordance with this, it must increase the concentration of electrons in the sample and, of course, its conductivity. However, the opposite result is observed. Perhaps this is due to the increase in the number of scattering centers in the boron sublattice. A key role in the relaxation of the electronic subsystems of $EuB_{6-x}C_x$ can be due to specific mechanisms associated, for example, with s-f Hubbard-Mott scattering and s-f super-exchange of localized f-electrons through the valence band electrons.

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