MAGNETIZATION AND MAGNETOTRANSPORT OF $RBaCo_2O_{5.5}$ (R=Gd, Eu) SINGLE CRYSTALS

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In $RBaCo_2O_{5.5}$ (R=Gd, Eu) the Co-ions are trivalent and can exist in three spin states, namely, the S=0 low spin state (LS), the S= 1 intermediate spin state (IS) and the S=2 high spin state (HS). The magnetization, the resistivity and magnetoresistance of single crystals of $GdBaCo_2O_{5.5}$ and $EuBaCo_2O_{5.5}$ have been measured over a wide range of magnetic fields and temperature. The phase diagram for both systems is consistent with previous reports. $GdBaCo_2O_{5.5}$ has a metal-insulator transition accompanied by a spin-state transition at T_{MI}≈365K. The data suggest an equal ratio of low spin (S=0) and intermediate spin (S=1) Co^{3+} ions below T_{MI}, with no indication of another spin state transition. The magnetization at low fields displays a transition to a highly anisotropic ferromagnetic phase at 267K, followed by another magnetic transition to an antiferromagnetic phase at a slightly lower temperature. The magnetization data is suggestive of weak correlations between the Gd-spins but no clear signature of ordering is seen for T > 2K. Significant anisotropy between the a-b plane and c axis was observed in magnetic and magnetotransport properties. The resistivity and magnetoresistance data imply a strong correlation between the spin and charge carriers. For $EuBaCo_2O_{5.5}$, the magnetic phase diagram is very similar to its Gd counterpart, but the magnetoresistance is positive rather than negative as for Gd, possibly because the nonmagnetic Eu ions have a small valence admixture, i.e. a valence slightly less than 3+.