

Transverse resistivity of acceptor graphite intercalation compound

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The goal: to reveal the peculiarities of transverse resistivity in intercalation compounds based on graphites with different degrees of structural perfection

Specimens of GICs

Host graphites		Intercalation method	Obtained specimens
 HOPG (High oriented pyrolytic graphite) d₀₀₂ = 0.335 nm the crystallite size L_b = 500 nm the parameter of preferred crystallite orientation η = 10⁴ 	 FPAG: (Fine-crystalline pyrolytic anisotropic graphite) d₀₀₂ = 0.340 nm the crystallite size L_b = 30 nm the parameter of preferred crystallite orientation η = 10³ 	 Intercalates: SbCl₅, AlCl₃ Two-temperature gas-phase method: The temperature of graphite is maintained above the temperature of intercalates, saturated intercalate's vapor is formed near the surface of graphite Intercalation time: 48 hours 	GICs with AlCl ₃ S = 1, S = 2. GICs with SbCl ₅ S = 2, S = 3, S = 4

The Experiment

The transverse resistivity temperature dependence ($\rho_c(T)$) has been measured by standard fourprobe method in temperature interval from 4.2 K up to 300 K. The measurement error did not exceed 0.5%.



The Experimental Results



Figure 1. Dependences $\rho_c(T)$ for GICs with SbCl₅ based on HOPG (a) and FAPG) (b): 1 – host graphite, 2 - S = 2, 3 - S = 3



 $H_{GG}^{(l)}$: matrix element of electron scattering on defects;

b)

 $H_{GG}^{(e-p)}$: matrix element of electron scattering on lattice oscillations outside the graphite layers;

 $H_{GG}^{(dip)}$: matrix element of interaction of charges and dipole moments

1: Independent of temperature.

2: Increases with increasing temperature.

3: Very large near the order-disorder transition temperature

Conclusions

In the terms of the proposed model, a positive resistance temperature coefficient for compounds of low stages and a negative resistance temperature coefficient for compounds of high stages is assumed for intercalation compounds based on the perfect graphite and a negative resistance temperature coefficient is assumed for low-stage compounds based on fine-crystalline graphite. Such difference in temperature coefficients of resistance arises as a result of the existence of different predominant charge carrier scattering mechanisms in the intercalation compounds based on structurally different graphites, which, in turn, is caused by different sizes of crystallites in the host graphites.

The decrease of transverse resistance for intercalation compounds based on imperfect graphite compared to intercalation compounds based on perfect forms of graphite is explained by the fact that the number of conducting charge channels perpendicular to the intercalant layers, which are the boundaries of crystallites, in intercalation compounds based on disordered graphite is significantly greater compared to perfect graphite.

References

1. Keiko Matsubara, Ko Sugihara, Itsuko S Suzuki and Masatsugu Suzuki. A- and c-axis resistivity and magnetoresistance in MoCl₅ graphite intercalation compounds. //J.Phys. Condens. Matter 11(1999) 3149 – 3160.