ELECTRICAL CONDUCTIVITY MECHANISM OF MAGNETIC SEMICONDUCTOR - NICKEL ZINK FERRITE

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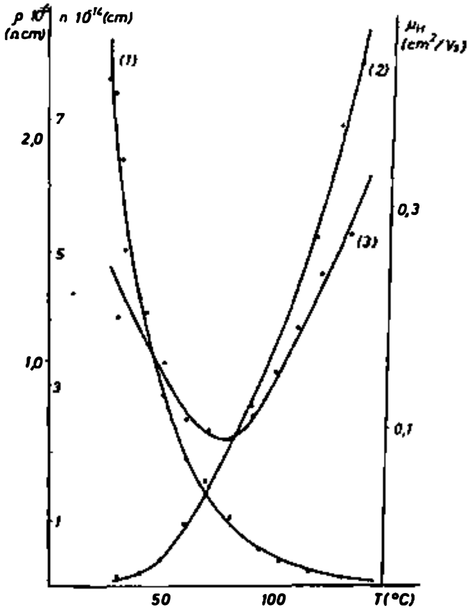
Complex investigation of $(Ni_{0.5}Zn_{0.5})Fe_2O_4$-ferrite with the aim to obtain data on the electrical transport mechanism in magnetic fields is performed. Measurement of EMF Hall effect and magnetization in magnetic fields up to 2kOe as well as of electrical resistivity is done.All the experiments are carried out in the temperature range from 30^oC to 180^oC.

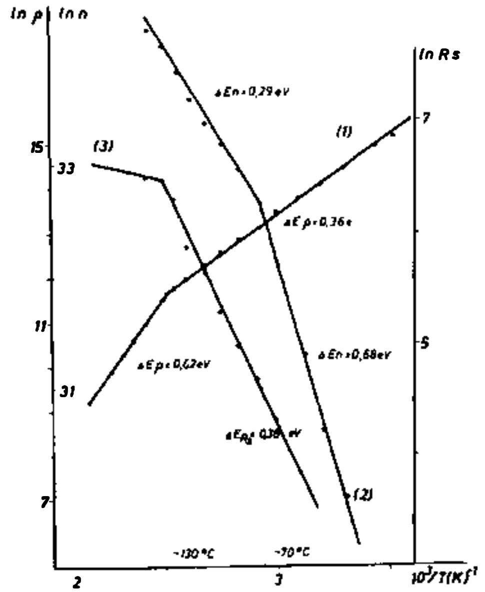
In Figs.1 and 2 results of these measurements are presented: dependence of electrical resistivity (ρ) concentration of the current carriers (n) as well as of Hall mobility (μH) on the temperature T (Fig.1.i.e. the dependence of $\ell n\rho$, ℓn n and anomalous Hall-effect (ℓn R_S) on 1/T (Fig.2). It can be observed (Fig. 2) that at $T=70^oC$ there is a break in the streight line ℓn n = f(1/T),(the corresponding activation energy changes from 0.68 eV to 0.29 eV) as well as in the line ℓn R_S = f'(1/T). At 70^oC the curve μ_H(T) has a distinctly apparent minimum (Fig.1); with the increase in temperature the mobility first decreases and then increases. On the other hand, $\ell n\rho$=f"(1/T) has a break at $T=130^oC$ to which corresponds the change in activation energy from 0.36 eV to 0.62 eV. Such a dependence of the mentioned values on temperature enables us to distinquish three different ranges in the investigated temperature interval:

I range, $T\leq 70^oC$. In this range there is an exponential increase of concentration of the current carriers and decrease of Hall mobility. Such type of electrical transport corresponds to the zone mechanism of conduction|1|.



1. ρ(T) ; 2 n(T) ; 3. μ(T)

Fig. 1.



1. ln ρ (1/T) ; 2. ln n(1/T); 3. lnRs(1/T)

Fig. 2.

II range, $70^{o} \leq T \leq 130^{o}C$. In this range there is an increase in concentration of the current carriers but with a smaller activation energy. There is also an increase in Hall mobility. Such type of electrical transport does not correspond to either the zone or to the jumping mechanism of conduction |1|.

III range, $T \geq 130^{o}C$. In this range concentration of the carriere increases according to the law valid for range II. Hall mobility increases according to the exponential law. Neither this type of electrical conductivity corresponds to the classical transport models.

It seems that the determined laws of change of n and μ_n suggest that the three mentioned temperature ranges correspond to the complex mechanism of conduction predicted by the theory of electrical conduction which is based on the model of a small radius polarons |2|, i.e. the theory of Hall effect which follows from this model |3|.

<u>References:</u>

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2. Bryksin V.V. and Firsov Y.A., FTT, 15, 3235 (1973).
3. Bryksin V.V. and Firsov Y.A., FTT, 16, 1941 (1974).