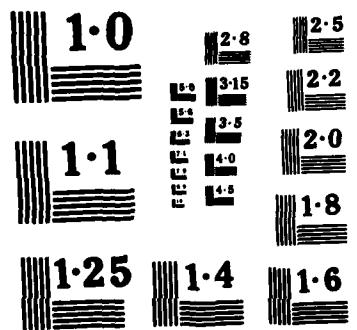


AD-A158 182 NEW METHOD OF DETERMINING THE CURRENT CARRIER 1/1  
CONCENTRATION IN A SUBSTANCE. (U) FOREIGN TECHNOLOGY DIV  
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MICROCOPY RESOLUTION TEST CHART

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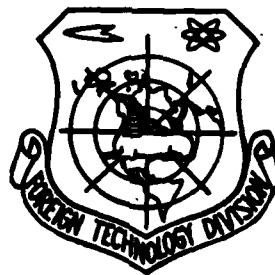
# FOREIGN TECHNOLOGY DIVISION



NEW METHOD OF DETERMINING THE CURRENT CARRIER CONCENTRATION IN A  
SUBSTANCE IN THE STATE OF SUPERCONDUCTIVITY

by

F.P. Golotyuk



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## EDITED TRANSLATION

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CONCENTRATION IN A SUBSTANCE IN THE STATE OF SUPER-  
CONDUCTIVITY

By: F.P. Golotyuk

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
WP.AFB, OHIO.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	<i>А а</i>	A, a	Р р	<i>Р р</i>	R, r
Б б	<i>Б б</i>	B, b	С с	<i>С с</i>	S, s
В в	<i>В в</i>	V, v	Т т	<i>Т т</i>	T, t
Г г	<i>Г г</i>	G, g	У у	<i>У у</i>	U, u
Д д	<i>Д д</i>	D, d	Ф ф	<i>Ф ф</i>	F, f
Е е	<i>Е е</i>	Ye, ye; E, e*	Х х	<i>Х х</i>	Kh, kh
Ж ж	<i>Ж ж</i>	Zh, zh	Ц ц	<i>Ц ц</i>	Ts, ts
З э	<i>З э</i>	Z, z	Ч ч	<i>Ч ч</i>	Ch, ch
И и	<i>И и</i>	I, i	Ш ш	<i>Ш ш</i>	Sh, sh
Й й	<i>Й й</i>	Y, y	Щ щ	<i>Щ щ</i>	Shch, shch
К к	<i>К к</i>	K, k	Ъ ъ	<i>Ъ ъ</i>	"
Л л	<i>Л л</i>	L, l	Ы ы	<i>Ы ы</i>	Y, y
М м	<i>М м</i>	M, m	Ь ь	<i>Ь ь</i>	'
Н н	<i>Н н</i>	N, n	Э э	<i>Э э</i>	E, e
О о	<i>О о</i>	O, o	Ю ю	<i>Ю ю</i>	Yu, yu
П п	<i>П п</i>	P, p	Я я	<i>Я я</i>	Ya, ya

\*ye initially, after vowels, and after ъ, ь; e elsewhere.  
When written as ë in Russian, transliterate as yě or ë.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	sinh <sup>-1</sup>
cos	cos	ch	cosh	arc ch	cosh <sup>-1</sup>
tg	tan	th	tanh	arc th	tanh <sup>-1</sup>
ctg	cot	cth	coth	arc cth	coth <sup>-1</sup>
sec	sec	sch	sech	arc sch	sech <sup>-1</sup>
cosec	csc	csch	csch	arc csch	csch <sup>-1</sup>

Russian English

rot curl  
lg log

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.



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odes  
or

## NEW METHOD OF DETERMINING THE CURRENT CARRIER CONCENTRATION IN A SUBSTANCE IN THE STATE OF SUPERCONDUCTIVITY

F. P. Golotyuk

This report proposes a fundamentally new solution to the problem of determining the current carrier concentration in a substance. The basis of the corresponding experimental method is a theory which considers the electron drift energy when considering the oscillatory processes in certain circuits [1].

We will consider a circuit in which external voltage which varies according to the law  $U = U_m \cos \omega t$  acts.

When considering the drift energy of the current carriers [1], the differential equation which describes the oscillatory process in a circuit with elements R, L, C has the form:

$$\frac{d^2 q}{dt^2} + 2\delta \frac{dq}{dt} + \omega_0^2 q = U_m \cos \omega t. \quad (1)$$

Here  $q$  is the charge on the capacitor plates,  $U_m$  is the amplitude of the applied voltage,

$$\delta = \frac{R}{2L(1+\lambda)}, \quad \omega_0 = \frac{1}{L(1+\lambda)C}. \quad (2)$$

$\lambda$  in formula (2) is equal to the ratio of the carrier drift energy

to the magnetic field energy of the latter, and it is determined by the expression [1]

$$\lambda = \frac{ml}{Ln_0q_0^2S} = \frac{mR}{Ln_0q_0^2\rho}, \quad (3)$$

where  $m$ ,  $q_0$  and  $n_0$  are the mass, charge and concentration of current carriers in the conductor from which the inductance is made;  $l$ ,  $S$  and  $\rho$  are the length, cross section and specific electric resistance of the conductor. The solution of equation (1) makes it possible to obtain the relationship

$$U_{em} = \frac{U_m}{\omega C \sqrt{R^2 + \left[ \omega L(1+\lambda) - \frac{1}{\omega C} \right]^2}}, \quad (4)$$

in which  $U_{em} = \frac{q_m}{C}$  is the amplitude value of the voltage on the capacitor;  $q_m$  is the maximum charge on its plates.

If we make the inductance of the circuit from the conductor considered above in the form of a solenoid with a double-wound winding, the self inductance coefficient  $L \approx 0$ . Then, introducing the designation

$$T = \lambda L = \frac{ml}{n_0q_0^2S} = \frac{mR}{n_0q_0^2\rho} \quad (5)$$

and changing to the effective voltage values

$$U_{em}^{(eff)} = \frac{U_{em}}{\sqrt{2}}, \quad U_m^{(eff)} = \frac{U_m}{\sqrt{2}},$$

we will rewrite relationship (4) in the form

$$U_{em}^{(eff)} = \frac{U_m^{(eff)}}{\omega C \sqrt{R^2 + \left( \omega T - \frac{1}{\omega C} \right)^2}}. \quad (6)$$

Knowing the frequency  $\omega$ , the voltage acting in the circuit, the capacitance, and the ohmic resistance of the circuit, and using a vacuum tube voltmeter to determine the voltages  $U_{em}^{(eff)}$  and  $U_m^{(eff)}$ ,

from formula (6) we can determine the value of  $\tau$ , after which we find the current carrier concentration from expression (5). Obviously, the value of  $\tau$  found from formula (6) will considerably exceed the error of measurement when the following conditions are satisfied

$$\omega\tau \gg \frac{1}{\omega_0 l}, \quad (7)$$

$$\omega\tau - \frac{1}{\omega C} \gg R. \quad (8)$$

As an example, we will consider the possibility of realizing conditions (7) and (8). Assuming that the solenoid is made from copper wire of length  $l = 1000$  m, with a cross section  $S = 10^{-8}$  m<sup>2</sup> and  $n_0 = 10^{29}$  m<sup>-3</sup> (there is one free electron per atom in the calculation), from formula (5) we obtain  $\tau = 5 \cdot 10^{-11}$  H. With a voltage frequency of  $f = \frac{\omega}{2\pi} = 100$  MHz and a capacitor capacitance of  $10^{-4}$  F,  $\frac{1}{\omega C} = \frac{1}{100} \omega\tau$ , so that condition (7) can actually be satisfied. Considering that  $\frac{1}{\omega C} \ll \tau\omega$ , and also relationship (5), we will rewrite condition (8) in the form

$$\omega \gg \frac{R}{\tau} = \frac{n_0 q_0^2 \rho}{m}. \quad (9)$$

In our case, the numerical calculation gives us  $\omega \approx 4 \cdot 10^{19}$  Hz; therefore, condition (9) cannot be realized. Since all metals have similar values of  $n_0$  and  $\rho$ , if the solenoid is made from other metal conductors, the value of  $\omega$  will be around  $10^{19}$  Hz and it also is impossible to satisfy condition (9). But when the conductor is in the state of superconductivity ( $R = 0$ ), condition (9) is satisfied.

Thus, the method in question of determining the current carrier concentration in a substance is appropriate when this substance is in the superconducting state.

#### REFERENCES

1. F. P. Golotyuk. Problem of considering the kinetic energy of directed movement of current carriers. See article in this collection.

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