

TRANSITION CONDUCTION ZONE IN TRINITROTOLUENE BEHIND THE FRONT OF A SHOCK WAVE

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We present the results of measurements of the distance from the shock-wave front (SWF), on which the resistivity (ρ) of the compressed explosive trinitrotoluene (TNT) changes from an initial value $\rho_0 > 10^{10}$ ohm-cm to a value $\rho \sim 10$ ohm-cm. The measurements were made at shock-wave intensities 17, 36, and 190 kbar (Jouquet pressure). We determined experimentally the time interval from the instant of the emergence of the SWF from the TNT sample (Fig. 1) to the instant of the decrease of the specific resistance of TNT to a value $\rho \sim 10$ ohm-cm.

The shock wave was produced by explosive devices described in [1]. The pressure on the SWF in the samples was calculated from the known state of the screen and the known dynamic adiabat of the TNT [2]. The thickness of the case TNT samples was 0.6 cm and the diameter

P, kbar	No. of experiment	Δt , μsec	$\overline{\Delta t}$, μsec	s, cm
17	1	0.47	0.63	0.23
	2	0.80		
	3	0.63		
36	4	0.34	0.46	0.17
	5	0.49		
	6	0.54		
190	7	0.07	0.07	0.05
	8	0.07		

P - pressure on SWF; T - measured time interval with allowance for corrections; $\rho_f = 10$ ohm cm in all cases.

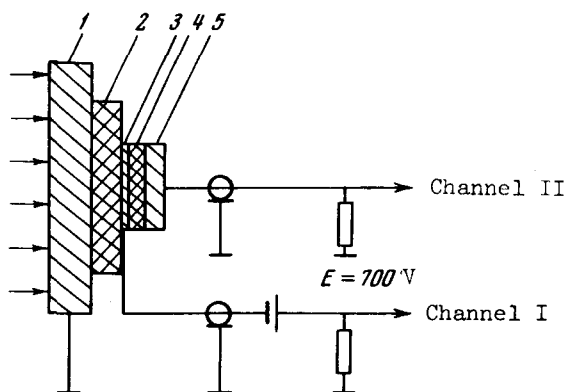


Fig. 1. Experimental setup: 1 - screen, 2 - TNT sample, 3 - copper foil 0.005 cm thick, 4 - LiF crystal 0.1 cm thick, 5 - electrode (copper). The diameter of 3, 4, and 5 is 1 cm. The arrows denote the direction of SWF motion.

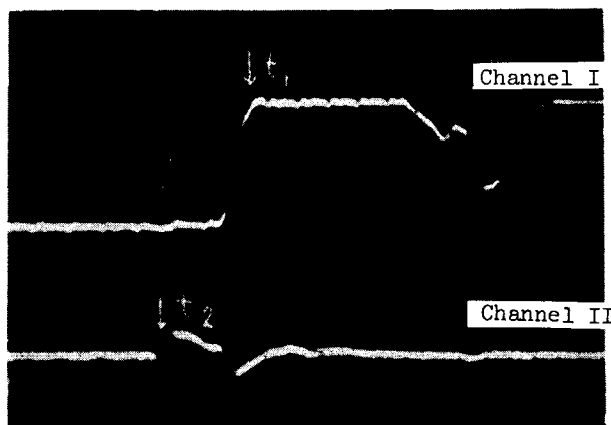


Fig. 2. Oscillogram of experiment (pressure 17 kbar); t_1 - instant of emergence of SWF from the LiF crystal; t_2 - instant of time at which the resistance of the TNT behind the SWF is $r \leq 10$ ohm. Time markers - 0.2 μsec .

was 3 cm. We used an OK-21 two-beam oscilloscope in the circuit. At the instant of the emergence of the SWF from the LiF crystal (4 on Fig. 1), the foil + LiF crystal + electrode system served as a polarization pickup [3,4], and a current surge was produced in the circuit of the second measurement channel when the SWF emerged from the LiF crystal. The first measurement channel was used to measure the resistivity ρ of the TNT sample, and therefore an external emf source (E) was connected in the circuit of this channel. The start of the deflection of the beam of channel I corresponded to a compressed-TNT resistance $R \sim 10^3$ ohm ($\rho \sim 10^3$ ohm-cm) and the maximum deflection corresponded to a value $R \leq 10$ ohm ($\rho \leq 10$ ohm-cm).

The time intervals on the oscillograms were determined by means of timing signals fed to both beams from a single generator. The synchronism of the beams was checked additionally by applying a reference signal from one source to both beams. In our experiments the length of the measurement cables of channels I and II were equal within one meter. The parameters of both circuits were chosen such as to exclude the influence of parasitic electric signals on the results of the measurements. The measured time intervals were corrected for the passage of the SWF through the thickness of the foil and for the possible breakdown of the TNT layer upon approach of the conduction zone to the foil. The total correction was ± 0.03 μ sec.

A typical experimental oscillogram is shown in Fig. 2. The results of the experiments are summarized in the table, from which it follows that the average resistivity ρ_f , calculated from the value of the final deflection of beam I, did not exceed 10 ohm-cm in all cases (pressures 17, 36, and 190 kbar).^{*} However, the distance s from the SWF at which the value of ρ_f is reached increases with decreasing pressure.

The existence of a distribution of ρ behind the SWF explains the difference between the width of the initial peak, seen on the oscillograms of the polarization current in TNT [6], and the width of the peak predicted by the theories of shock polarization of dielectrics [6,7]. It is assumed in the latter that ρ varies jumpwise on the SWF.

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^{*} The value of ρ_f obtained for the detonation (190 kbar) does not contradict the results of independent experiments [5].